THE

AMERICAN NATURALIST

VOL. XXX. April, 1896. 352

THE BEARING OF THE ORIGIN AND DIFFERENTIATION OF THE SEX CELLS IN CYMATOGASTER ON THE IDEA OF THE CONTINUITY OF THE GERM PLASM.[1]

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At the meeting of the American Microscopical Society last August I read a paper on the Evolution of Sex in Cymatogaster, of which the present paper is a part. It is not, and was not intended as a full discussion of heredity, but contains observations and conclusions forced upon me while tracing the sex cells from one generation to the next in *Cymatogaster aggregatus* Gibbons, one of the viviparous perches of California.

Since writing it, I have received from Dr. Minot his article "Ueber die Vererbung und Verjüngung," which is just being republished in the NATURALIST. I have thought best to present my results as read at the Ithaca meeting, with a note written after the receipt of Dr. Minot's article, although the details of the observations on which the conclusions are based may not appear for some time.

[1] Contributions from the Zoological Laboratory of the Indiana University, No. 12.

The origin of the heredity cells may be explained in one of three ways:[2]

I. The sex cell is the product of the whole organism, and is in this apart from the other tissues. This is the *Pangenesis* of Darwin.

II. The sex cell is an unchanged but increased part of the sex cell of the previous generation, and something apart from the rest of the body. This is *Jaegerism*, or, more popularly, *Weismannism*, and, according to it, the body has no influence over the hereditary cells and changes arising during the life of one individual cannot be transmitted to the next generation.

III. The sex cell is the product of histogenesis and of precisely the same significance and origin as any other cell in the body. This view is held by Morgan, Minot and myself.

As a corollary of the last two is the fact that "in the ancestry of the individual cells of which our body is composed there has never been a death."

The first two theories are not based on observation. They have been evolved from the attempts to explain the heredity power of the sex cells.

The idea of the cellular continuity of successive generations first suggested by Nussbaum in 1880, is now generally accepted. Indeed, there is, perhaps, now no one who would contend that the reproductive cells are new formations in the individual. The reproductive cells are known to be of the same origin as the retinal or any other series of cells. There is but little less unanimity over the idea of the continuity of the unchanged germ plasm, although the number of observations bearing on this point have, necessarily, been very limited.[3] So often is the idea restated without actual examination of the data, the whole subject has become hackneyed. I have taken up this subject because it seems to me the conditions observed in Cymatogaster warrant a conclusion differing from the one generally accepted.

[2] See Osborn, Am. Nat., 1892. Morgan, Animal Life and Intelligence, 1891, p. 131.

[3] Boveri, Befruchtung in Ergebnisse der Anatomie und Entwicklungsgesch, I, 1892, records an apparent case of unchanged transmission.

There is no doubt concerning the continuity of the reproductive cells in Cymatogaster; they may be followed from very early conditions till sexual maturity without once losing their identity. No somatic cells are transformed into reproductive cells, and the comparative constancy of the number of the latter present in any embryo up to 7 mm. long makes it probable that none[1] are ever changed into any other structure. These statements apply with equal force to other tissues.

The difference between the reproductive and the somatic cells is that the latter, after development has begun, continue to develop, divide, grow and adapt themselves to their new duties without intermission. The sex cells, on the other hand, stop dividing at a certain point and remain at apparent rest for a long period. Owing to this arrest in division the sex cells soon stand out prominently as large cells among the smaller somatic cells. Such an arrest in segmentation has been observed in a number of other animals in which the reproductive cells are early segregated, and it cannot be without meaning. It has been supposed that during such periods of apparent rest the cells remain dormant, retaining their embryonic character unchanged. I do not think this is the true reason for the difference of development between the soma and the reproductive cells. The reason seems to me to lie in the fact that the sexual organs are the last to become functional, and their development is consequently retarded. The sex cells, when first segregated—that is, when they first lag behind in segmentation—are not exactly like the ovum from which they have been derived, and there is just as true histogenesis in their development into the reproductive tissues as in the case of any other embryonic cells into their corresponding tissue. Even during the long period of rest from segmentation, the process of tissue differentiation produces a visible and measurable change. But the difference between embryonic cells and undifferentiated reproductive cells being small, the histogenic changes in them during early stages is correspondingly small. This small change has been supposed to amount to no change, and has given rise to that fascinating " myth ", the

[1] For possible exceptions see Eigenmann, Journ. Morph., V, No. 3, 1891.

hypothesis of the continuity of unchanged germ cells, and later, when observation in other animals had made this theory untenable, to the theory of the continuity of unchanged germ plasm which is beyond the ken of direct observation.

If the sex cells are the result of histogenesis, it will be necessary to explain their peculiar power. They seem to me to be due to the same processes that have given the retinal cells their peculiar properties.

Assimilation, reproduction and the closely allied hereditary power are the diagnostic characters of protoplasm. These, with numerous other powers, such as contractility, conductivity and irritability, are the properties of every protozoan cell. Even here we find that certain of these functions are more or less restricted to definite parts of the cell. In the higher animals this differentiation has gone so far that definite functions predominate in highly specialized cells to almost the exclusion of the other powers.

With this division of labor and the consequent histogenic differentiation of definite cells in the metazoan corm for purposes of contraction, conduction and irritation, we have also the differentiation for heredity, and it would be surprising if we did not.

In lower forms, where the cells of the body often perform many duties, where the division of labor and histogenesis has not been carried to the extreme, many of these cells also retain the hereditary power to a great extent as shown in the power of budding or regeneration.

There seems to he no necessity to conjure up a substance and processes in the genesis of the reproductive tissues different from those obtaining in the muscular tissues.

During the long ages of the rise of animals those possessing sufficiently differentiated contractile tissue to move the corm to food or from danger have survived, and in precisely the same way those corms containing cells capable of developing into other similar corms have survived. Similar causes have operated in producing each tissue.

The sex cells are proven to influence the formation of the sex ridge. The peritoneal cells rise to form the ridge only

when sex cells are present without regard to whether this position is normal or not.[5] If the sex cells thus influence the surrounding tissue, may we not safely assume a reciprocal influence of the surrounding tissues on the reproductive cells?

Sexuality can first be distinguished not by the difference in the sex cells, but by the character of the peritoneal covering. While this difference in the peritoneal covering may be the expression of an invisible difference existing in the reproductive cells, it is quite possible that sex is determined by the body. In frogs, butterflies, etc. the sex determining power of the soma has been experimentally demonstrated. Later it is well known that the character of the sex cells influences the remotest parts of the organism, although we are not at all familiar with the processes by which this is accomplished.

Changes in the sex cells introduced by the body which do not become apparent until the development of the cells into young, seem, therefore, to be not impossible, although we are entirely unable to tell just how such a change might be accomplished.

Since writing the above, I have received, through the kindness of the author, Dr. Minot's "Ueber die Vererbung und Verjüngung." While the views expressed are not identical with those given in the present chapter, there is considerable agreement. Dr. Minot recognizes that the problem of the origin of the reproductive cells is also the problem of the origin of the tissue cells (p. 580), and that "a germ plasm in the Weismannian sense does not exist." So far we agree. According to him all parts inherit from the germ and possess, as well as the reproductive cells, the power of multiplying and morphogenesis, but this power cannot manifest itself on the part of the somatic cells because the conditions of the body prevent it. The conditions are the increased amount of protoplasm and the specialization of the tissues. According to my views it is not so much a high state of tissue differentiation which *holds captive* the morphogenic power in muscle cells for instance as it

[5] In one interesting larva a few of the sex cells were belated in their migration and situated in front of the normal position. Sex ridges (germinal bands) formed about these sex cells entirely independent of and separated from the sex ridges occurring in the normal place.

is the process of tissue differentiation which *emphasizes* the contractile power in the muscle cell, at the same time *limiting* and finally *eliminating* the morphogenic power, and which gives the sex cells morphogenic power in such marked degree while it deprives them largely of contractile power. In a former paper,[6] I stated this view thus: "The segmentation nucleus of metazoa contains, as in the infusoria, both micro and macro nuclear elements, but these are retained in varying proportions in its descendants, *i. e.*, in the cells of the adult organism. Through a process of division of labor the power of rejuvenescence becomes restricted to comparatively few of the cells derived from the segmentation nucleus."

While Minot's views are in part borne out by the conditions in Cymatogaster, the italicised part of the quotation below finds no support, and is negatived by all the observations made in Cymatogaster. His conclusion, as translated by me, is: "Somatic cells are simply cells in which the activity of heredity is prevented by senescence, viz.: tissue differentiation, *but the somatic cells can, under favorable conditions, be translated into the rejuvenated stage and then develop the most complete or, at least, more complete, hereditary power.*"

ABSTRACT OF OBSERVATIONS ON WHICH THE ABOVE CONCLUSIONS ARE BASED.

The sex cells originally segregated retain their individuality, but undergo a measureable change between the time of their segregation and 7 mm. long larvæ. Soon after the larva has reached a length of 7 mm., the sex cells begin to divide. In the meanwhile they have migrated laterad and lie, for the most part, in a longitudinal groove formed by a duplication of the peritoneum into which a few peritoneal cells have also migrated. *In one such case an extra sex ridge was formed much further forward than usual, in connection with a few sex cells which were accidentally belated in their migration.* The peritoneal cells which have migrated into the sex ridge give rise to the entire stroma of the future sex glands, and together with the sex cells form a core quite distinct from the covering

[6] Bull. U. S. Fish Comm., XII, 442, 1894.

of peritoneum. Posteriorly the sex ridges of the two sides are united into a single ridge. There is considerable variation in the rate of segmentation in larvæ of the same size, but the following table will give an idea of the segmentation and the number of cells in successive stages:

Size of larva.	No. of sex cells.	No. of generations from fertilization.
45–5 mm.	9–15	5
8	22	6
10	28–183	6–9
12	39–143	7–9
15–17	638–2280	11–13 sexes distinct.
16–25	2200–8000	13–15

The sexes can first be distinguished not by the differences in the sex cells, but in the tunic of peritoneal cells. A small groove on the outer ventral part of the sex ridge is the first indication of the ovarian cavity and the surest criterion of the female. In the male the sex gland remains much more circular in cross section and no groove is developed. Much later histological differences in the sex cells themselves can be made out. The long slender chromatin threads of the female cell just before dividing are represented in the male by short, thick bars.

THE HISTORY AND PRINCIPLES OF GEOLOGY, AND ITS AIM.

BY J. C. HARTZELL, JR., M. S.

(*Continued from page 183.*)

Lamarck and Defrance earnestly engaged in study of fossil shells, and the former, in 1802, reconstructed the system of conchology and introduced into it the new species collected by the latter from the strata underlying the city of Paris and quarried for the construction of its buildings. Six years previous to this Cuvier had established the different specific character of fossil and living elephants and he devoted himself to researches throughout the remainder of his life. Jameson, in 1808, pointed out the nature of all the rocks and the mode in which they were formed, and made use of the observations

of Desmorest, who, in 1768, traced the origin of basalt to the crater of volcanoes.

In 1807 the Geological Society of London was established with the professed object of encouraging the collection of data and the making of observations. In 1819 the Society published a map of England by the aid of Greenough. About the same time Buch prepared a similar map of a large part of Germany. A geological survey of France was ordered in 1822 by the French government, and as a result a geological map was published in 1841. Conybeare and Phillips published a treatise on the "Geology of England and Wales," in 1821. In 1814 Aiken published his work on mineralogy, which had a large circulation at home and in this country. Previous to this Sowerby published a work on "British Mineralogy, illustrated with colored plates," but the date of which I do not know. The publication of the Geological Map of England, in 1815, by Smith, may be said to form an epoch in the history of geology.

In 1809 Maclure published an article on "Observations on the Geology of the U. S., explanatory of a Geological Map," and he is rightly called the father of American geology. He visited all parts of the Union and all the principleming ni districts of Europe. In 1817 he presented a report to the "Philosophical Society of Philadelphia" of his work, and accompanied it with a colored map. In 1816 and 1817 he visited the Antilles and published a paper on their geology. In 1810 Bruce, of New York, published the first purely scientific journal supported by original American contributions. His journal was devoted principally to mineralogy and geology. Science was also promoted by the collections in the colleges and societies, and by those made by scientific men. In 1816 Cleveland published a treatise on mineralogy. In 1818 Dana published a detailed report on the mineralogy and geology of Boston and vicinity. In the same year the American Journal of Science was first published. The first geological survey made by State authority was that of North Carolina in 1824.

In 1830 the Principles of Geology, by Lyell, appeared and has most powerfully influenced the direction of scientific

thought in the 19th century. It broke down the belief in the necessity of stupendous convulsions in past times. He adopted and improved the views of Hutton, eliminating the baseless theories mingled with them. He rendered great service in elucidating North American geology, and published his travels on this continent in 1845 and 1849. His "Geological Evidences of the Antiquity of Man," published in 1863, startled the public by its advocacy of Darwin's theory in the "Origin of Species."

And so the science has advanced with rapid strides and is solving the problems that are constantly arising in regard to our planet, and upon its fixed data are based many of the fundamental principles of philosophy.

Having considered the history of the progress of geology, let us now consider its aim and the fundamental principles upon which the geologist bases his work.

In the broadest sense, geology is the science whose province is the planet upon which we live, its history from the beginning to the present, including changes which have occurred in regard to the condition at different periods, its several physiographic features, its atmosphere, temperatures, and aqueous bodies, and its life at different stages. In a nutshell, the evolutionary progress of the earth.

The narrow or commonly accepted view does not consider the changes that have occurred, other than those that occurred to the visible portion of the earth. Back of what is supposed to be the earliest formation, it does not attempt to go.

The latter view is sufficient for the ordinary geologist or for the geologist who does not care to speculate on hypotheses which refer to the origin of the earth; but to the geologist who is anxious to grapple with problems which require a drawing upon the imagination for solution, this is not enough. Chemists are not satisfied to study a drop of water, but they are anxious to know its origin; its composition is not sufficient for them. Botanists and zoologists desire to know the origin of plants and animals, not merely their structural and physiological features.

Geologists who study the earth, not merely to satisfy their own curiosity as to the *present* condition of things, but for the purpose of advancing the science, and unraveling the mysteries of the past, in order to produce a history of the planet as accurately as human knowledge in its present condition will permit, are only satisfied with the broad and comprehensive view.

Geology, by the aid of astronomy and physics, therefore, begins with a great nebulous mass, of which all celestial bodies were component parts. It traces the evolution of each body, and that of the earth in particular. Starting when the earth was thrown off as a ring of cloudy or gaseous elements, it traces it through its transformation into a sphere of molten matter surrounded with gases, through which the parent body, the sun, could not penetrate. We learn of the war that existed between the congealing surface and the liquid interior in which the former came off victorious, and formed a crust through which the latter seldom broke. Then began the war between the condensing vapors and the heated crust, in which the latter succumbed to the overpowering element that fell upon it and fairly covered it.

Geology tells us of the life that existed in this mighty ocean after it became sufficiently cooled, and in the powerful internal movements that resulted in the upheaval of masses of rock that were to be the nuclei of the present continents, the history and the formation of which is traced with great minuteness, and the life of each is described with great care, from the lowest forms to the highest, and also the period in which each form lived.

There are several principles by which the geologist is guided in answering the questions that continually arise as he studies the earth with its many characteristics.

1 In the first place, he understands that *geology is an inductive science.* That is, it is a process of demonstration in which a general truth is gathered from an examination of a self-evident truth. Let me illustrate: From the study of modern glaciers he learns certain facts in regard to conditions necessary for their formation, their modes of action, and the results of those actions.

Now, whenever a geologist sees the results of some great force and those results are similar to the phenomena produced by glaciers, he concludes that at some previous time the conditions were such as to make it possible for glaciers to exist in the locality in which his observations were made, for no other force could produce them.

2 He reasons that *all affects must be referred to secondary causes.* In other words, law governs all phenomena, and forces are so balanced as to produce all *known* and *unknown phenomena.* All events that have transpired in the development and configuration of the earth have been brought about by law. In the formation of glaciers certain laws are obeyed, and those laws are always obeyed unless an equilibrium is sustained between them and some other laws are overbalanced.

When the conditions are favorable for the action of *glacial laws* glaciers will be found. The same principle holds good in the distribution of life.

3. *The forces in existence to-day are capable of producing all phenomena that have and may occur.* Therefore, the geologist must study the methods by which they are producing changes at present, and thereby be able to judge of what took place ages ago, and the manner in which great events transpired. In other words, *the past is understood by the present* and to some extent *the future may also be understood.* No new law is, nor has been, necessary for the explanation of phenomena and, therefore, there have been no accidental happenings. There may be laws that man has not as yet learned the nature of, and they may be so balanced as to be beyond man's comprehension, but that there are being or have been created new laws, and that there are accidents, the geologist does not admit.

4. *The earth is undergoing and therefore has undergone changes.* He sees this in studying the phenomena of denudation and disintegration. He sees that the mountains are being destroyed by chemical and physical agencies, and that they are being gradually carried into the valleys, and then into the sea. This, he reasons, must have been going on ever since the first continent made its apppearance.

5. Finally, from a consideration of the above principles, the geologist realizes that his *work must be systematic,* and that the bulk of it *must be done in the field. Field investigation is indispensable. Laboratary work holds a subordinate position.*

It is safe to say that geology has advanced more rapidly than any other science, and the number of those who are making a specialty is steadily growing. New periodicals devoted to the science are continually appearing, and its literature is quite comprehensive. Very little attention was paid to it in our colleges at no late date, but to-day it occupies a prominent position.

The great advance which has been made is due to systematic field work, followed by laboratory work, and the latter is of but little value from a geological standpoint unless it is based upon accurate field investigation. It is necessary to reduce to a practical formula the data secured in the field, and to have a definite method of procedure, for without such, much time is wasted, and many results that otherwise would have been valuable are entirely lost. Mere conjecture must not be indulged in, but " work persistently back from the seen and known to the unseen and unknown," should be the maxim. Conclusions must not be arrived at too hastily.

Professor Dana once said, " I think it better to doubt until you know. Too many people assert, and then let others doubt." Hence, in drawing conclusions from the results of field and laboratory work, be sure you are right, before giving publicity to them, and if a doubt exists, state it, and be willing to change your theory. Dana says, " I always like to change when I can make a change for the better."

It is obvious, from what I have said, that geology is a field science. Different characteristics of the earth's surface cannot always be taken into the laboratory for study at leisure, and it is necessary to see the objects under study if we would arrive at correct conclusions and fix them indelibly in our minds. Facts then become real, and we acquire a correct understanding in regard to the forces that have been at work preparing this planet for man.

It is necessary to have a knowledge of other sciences if one would make practical use of geology, that is, to understand the many phenomena that are presented to him.

Natural philosophy and chemistry are necessary in order to determine the composition of rocks and to understand how they were formed and changed. Botany is necessary to understand paleobotany, zoölogy is necessary to understand paleozoölogy, astronomy figures very prominently in the determination of the relations of this planet to other heavenly bodies. Anything that the telescope and the spectroscope reveal is of geological importance, and bears upon the past and future condition of the earth. Mathematics is constantly in use, and without that science little or nothing could be accomplished.

The foundation work of a geologist, therefore, should be a knowledge of the natural sciences, for without them he will be materially hampered in his work.

Geology is practical as well as literary in nature. Every agriculturalist would become more scientific, and would reap better "crops" if he had a knowledge of the science, for it gives a knowledge of soils and fertilizers. To the engineer it is of great importance, for thereby he understands drainage and the best methods for excavating. It is of great importance to the manufacturer, for he can better understand clays, ores, fuels, etc., and in mining it is of great value for it enables the miner to understand the nature of the rock in which the metals occur and assists him in "prospecting."

This use of the science is termed "Economic Geology" and is of inestimable value and importance in developing systematically the resources of a state or of a nation.

The United States government has realized the importance of thorough and accurate investigation of this vast country of ours from an economic standpoint, and established the U. S. Geo. Survey in 1879 for this purpose. Most of the states have their surveys and work for the same ends, but on a smaller scale, and assist, and are assisted by, the government survey, and so work in harmony with each other.

Individuals are at work gathering information in regard to particular formations, correcting mistakes, advancing new theories, devising new plans for more thorough and accurate works and imbuing students with the grandeur of the science.

What is there more sublime than a science that reveals the universe in all its beauty and grandeur and as the result of the balancing of forces which emanate from a creative will? Geology reviews the history of the planet from the earliest known formation to the present. Back of this it goes by retrograde calculation, and hence we have a complete resumé from the time "the earth was without form and void," to the phenomena observed to-day. It tells us of periods of time of immeasurable duration, during which was being molded that upon which it would be possible for life to exist, and over which mind should rule.

There is no science which presents so many problems to be studied, nor in which so much of interest can be taken. It carries one over plains, up the rugged mountains and down into valleys. On every hand is found something new upon which to concentrate the mind, and which demands a satisfactory explanation. How came these plains, these mountains, these valleys? How came those masses of rock, thousands of feet high? Why is sandstone here, limestone there, and granite yonder? What mean those remains of animals and plants that are not in existence to-day? Why are those masses of rock in every conceivable position? Whence came the waters and the land? The plants and animals? Is there a reason for all we see? Are these things accidental, or was there a purpose in their formation?

And so questions crowd upon us, and fill us with wonder and admiration, and with a determination not to be satisfied until they are answered. We see that law is at work, fashioning the universe, and we have brought very forcibly to our minds the fact that there was a purpose involved in the creation of the universe, and that from this realized grand conception is being evolved a divine purpose. That which at first appeared to be outside the domain of law, is seen to be the result of the balancing of forces; and we come to realize the fact

that law pervades the universe, and although we do not know as yet the way in which these laws are balanced to produce all phenomena, that they are so balanced as to produce harmony, and that in proportion as the human mind develops it will be capable of grappling with problems that are not now within its reach.

LIFE BEFORE FOSSILS.

By Charles Morris.

(*Continued from page* 188.)

Such a new stage of existence may have been essayed frequently. The dwellers in the early seas, in their descents below the surface, must often have come into contact with the bottom, and at times temporarily rested upon it. This contact with hard substance doubtless produced some effect upon them, and certain variations in structure may have proved of advantage in these new circumstances and been retained and further developed. Particularly if food was found there, and habitation on or near the bottom was thus encouraged, would such favoring variations tend to be preserved.

But, as has been said, myriads of years may have passed in the slow development of swimming pelagic animals before this phase of evolution was completed. And, perhaps, not until this was fully accomplished did contact with the bottom set in train a new series of changes, and in time give rise to the greatly transformed bottom-dwellers. The change, indeed, was a great one, if we may judge by the wide diversity in character between the swimming embryos and the mature forms of oceanic invertebrates, and must have needed a long period of contact with the bottom for its completion. Yet it was probably much more rapid than had been the preceding pelagic development. Contact with solid substance was a decided change in condition, and may have greatly increased

the preservation of favorable variations. And the area of habitation on the single plane of the sea bottom is so restricted as compared with that within the many planes of oceanic waters, that the struggle for place and food must have been greatly increased, and the development and preservation of newly adapted forms have been more rapid in consequence.

This may seem to bring us to the very verge of the kingdom of life as it is known to us from the oldest fossils yet discovered. Yet in truth we are probably still remote from it. We are still dealing with soft bodied animals, not with those possessed of the hard external skeletons from which fossils are produced. There is no good reason to believe that mere contact with the earth induced the previously naked swimmers to clothe themselves in solid shells. In truth, the earliest bottom-dwellers may have long continued soft bodied, the hard case or shell being only slowly evolved. The mantle of the mollusk, for instance, with its shell-secreting glands, is not likely to have been a primary accessory of molluscan organization. The same may be said of the chitin-forming glands of the crustacea, and the analogous glandular organs of other types. Such conditions must have developed slowly, and their appearance was probably due to an exigency of equally slow unfoldment.

For now we come to another highly important problem, that of the true disposing cause of the development of dermal skeletons, on which there exists some basis for speculation. In truth the fossils preserved for us in the Cambrian rocks have an interesting tale to tell which has a strong bearing upon the story of animal evolution. And this is, that all these bottom-dwellers, with the exception of the burrowing annelids, became covered with what was probably defensive armor. They all seem to have sought protection in one way or other, and in so doing became in a measure degenerated forms of life, their former ease of motion being now partly or wholly lost.

All this represents an interesting stage in the process of evolution, and indicates some special exigency in life conditions which the animals of that age could only meet by rendering themselves heavy and sluggish with a weight of inclosing

armor. This new phase of evolution may have proceeded very rapidly, many forms of early life disappearing, while those that quickly became armored survived.

What was this exigency? Protection, apparently, as is above stated. But protection from what? Against what destructive foe did these ancient animals need such strong defence? Which among them was the rapacious creature whose ravages imperilled the existence of all the others? Certainly not the sponge or the cœlenterate; they feed on smaller prey. The mollusk or the echinoderm, in their agile unclad state, may have been actively predatory, but they were among those forced to seek protection. Of the known forms the trilobite seems most likely to have been the aggressive foe in question. It was the largest, the most abundant, and, perhaps, the most active of them all, its size and numbers indicating an abundance of easily obtained food, while its great variety of species points to the existence of varied conditions of food or methods in food getting.

To all appearances the trilobite was then the lord of life, the Napoleon of that early empire. Awkward and clumsy as such a creature would appear now, it was then superior in size, strength, and probable agility to all other known animals, while its numbers and variety indicate that it was widely distributed and exposed to all the varying conditions of existence at that time. What a hurrying and scurrying there must have been among those small soft creatures to escape this terrible enemy, from whose assaults nothing seems to have availed them but an indurated external covering, too hard for its soft jaws to master. As the prey became protected in this manner the destroyer probably improved in strength of jaw, and there may have been a successively more complete growth of protective devices in the prey and of powers of mastication in the foe. And thus arose the conditions which first made fossilization possible, in the development of a series of armor-clad creatures which were really late comers upon the stage of life, remote as they seem when measured by our standard of time.

But the story is only half told. The trilobite, as it is known to us, is under armor also. Not only is it clothed in a dermal

skeleton, but, in its later forms, is capable of rolling up into a hard ball with no part of its body exposed. Evidently the destroyer himself in time came into peril and needed protection. Some still more powerful and voracious foe had come upon the field, and the triumphant trilobite was forced to acknowledge defeat.

We cannot well imagine any of these animals assuming such armor except for protective purposes. The weight laid upon them rendered them slow and sluggish, fixed some of them immovably, and greatly decreased their powers of foraging. The only cause which seems sufficient for their assuming this disadvantageous condition is that of imminent peril—a peril which affected all known forms alike.

Whence came this peril? Where is the voracious foe against whom they all put on armor, even the preceding master of the seas? No trace of such a creature has been found. In truth, we cannot fairly expect to find it, since it was probably destitute of hard parts, and left behind it nothing to be fossilized. It had no foe and needed no armor, while lightness and flexibility may have been of such advantage to it that armor would have proved a hindrance. It probably was a swimming creature and thus left no impress of its form upon the mud. It is to this unknown creature that we must ascribe the armored condition of all known forms of life at that period, even the later cephalopods, large and powerful mollusks, becoming clothed in a cumbrous defensive shell, which they were obliged to drag about with them wherever they went.

It is a strange state of affairs which thus unfolds before our eyes. All the life we know of seems diligently arming itself against some terrible enemy, which itself has utterly vanished and left as the only evidence of its existence this display of universal dread. The creature in question would appear to have been without internal or external hard skeleton and without teeth, trusting to indurated jaws for mastication. At a later date, when its prey became less easily destroyed, teeth may have developed, and it is possible that we have remains of them in the hard, cone-like, minute substances found in the lower Silurian strata, and known as conodonts.

If we may try and rebuild this vanished beast of prey from conjecture, aided by collateral evidence, we should consider it an elongated, flexible form, developed from some swimming worm-like ancestor, perhaps like the Ascidian embryo, stiffened internally by a cord of firm flesh extending lengthwise through the body, and moving not by cilia, but by the aid of fleshy side flaps, the progenitors of the fin. We conjecture it to have been, in short, the early stage of the fish, a creature perhaps of considerable size and strength, due to the abundance of easily obtained food, but as destitute of hard parts and as little likely to be fossilized as Amphioxus.

We may offer this conjecture with some safety, for it is not long before we come upon actual traces of fish, and of a degree of development which indicates a long preceding stage of evolution. In fact, the fish in time appears to have been forced to put on armor, as its prey had earlier done. Internicine war began in the fish tribe itself. A wide specific variation arose, with great differences in size and strength, the stronger attacked the weaker species, and eventually two distinct types of fish appeared, the Elasmobranch and the Ganoid ; the former, represented to us by the modern sharks, being much the most powerful and voracious, and holding the empire of the open seas, while the latter dwelt in shallower waters. The Ganoids, preying on the bottom forms, become themselves the prey of their strong and active kindred, and, as a result, the evolutionary process just described was resumed. The weaker fish put on armor, in many cases heavy and cumbrous, a dense bony covering which must have greatly reduced their nimbleness, but which safety imperatively demanded. It is these armored forms that first appear to us as vertebrate fossils; the first fish, as the first mollusk or crinoid known to us, being the resultant of a very long course of development. As regards the Elasmobranchs, they, too, became in a measure protected, though not sufficiently to indicate any very active warfare among themselves.

There is little more which we can say in this connection. The story of the evolution of life bears an analogy worth mentioning to that of the development of arms of offense and de-

fense among men. After thousands of years of war with unarmored bodies, men began to use defensive armor, the body becoming more and more covered, until it was completely clothed in iron mail, and became rigid and sluggish. In the subsequent period offensive weapons became able to pierce this iron covering, and it was finally thrown aside as cumbrous and useless. A similar process is now going on in the case of war vessels, they being clad in heavy armor, which may yet be rendered useless by the development of cannon of superior piercing powers, and be discarded in favor of the light and nimble unarmored ship.

The analogy to animal evolution in this is singularly close. After long ages of active warfare between naked animals, defensive armor was assumed by nearly every type of life, except the lowest, highly prolific forms, and the highest, which had no foes to fear. But the powers of offense grew also, and in time the employment of armor ceased, as no longer available, its last important instance being that of the ganoid fishes. The later fish reduced their armor to thin scales, and gained speed and flexibility in proportion, while in land animals armor was seldom assumed. In several instances creatures have gone back to the old idea, as in the armadillo, the porcupine, the turtle, etc., but the thinly clad, agile form has become the rule, armor no longer yielding the benefit that was derived from it in the days of weak powers of offense. This result is a fortunate one, since with increase of agility mental quickness has come into play, the result being a development of the mind in place of the old development that was almost wholly confined to the body. In the highest form of all, that of man, physical variation has almost ceased, in consequence of the superior activity of mental evolution.

In conclusion it must be admitted that there are certain formations in nature which seem to militate against the argument here advanced. I have already spoken of the much questioned Eozoon canadense. In addition there are the beds of limestone and graphite in the Laurentian formation. But these prove too much for the advocates of their organic origin. If so large a fossil as Eozoon had appeared so early, the subse-

quent barrenness of the rocks would be incomprehensible. And had coral animals and large plants capable of producing such masses of limestone and graphite existed so early, the absence of any fossils earlier than the Cambrian would be inexplicable. It is acknowledged, however, that such formations might have been produced by inorganic agencies, and the facts strongly indicate that such was their origin, and that fossils began to be preserved very shortly after the power in animals to secrete hard skeletons appeared.

BIRDS OF NEW GUINEA (FLY CATCHERS AND OTHERS).

BY G. S. MEAD.

(*Continued from page* 195.)

The Thickheads (*Pachycephala*) are of many species and scattered widely over the Archipelago. Many have come under trained observation only during recent years. Probably many more await discovery.

Pachycephalopsis poliosoma, Gray Thickhead, was discovered by Mr. A. Goldie in Southeastern New Guinea, and owing to its distinctive coloration was classed as a new genus. It is really one of a group of birds which might form a subgenus and is accordingly so divided by Mr. Gadow. Above the general color is dark gray, almost brown, with the head still darker. The square, rather short tail is also dull of hue. Beneath is dull gray, lighter on the abdomen and tail coverts, whitish to white on the jugulum, throat, chin and side face. It is a pretty, soft colored little bird about 6 inches long, sufficiently numerous among the mountains of the Astrolabe range to be called common.

Pachycephala melanura ranges widely over Northern Australia and the Archipelago. The general color above is olive-green ; wing coverts, tail, head and an irregular band passing

over the head, neck and breast, black and glossy black. The under parts, with a broken collar about the neck, are a warm light yellow. Throat a pure white. Whitish lines the under side of the wings and tail. Bill and feet black. The female lacks the vivid coloring of the male, being brownish where he is a jet black, buff or whitish where he is a bright gold. Length 7 inches.

Very like the above, but of reduced size, is *Pachycephala schlegelii,* whose total length is under 5.5 inches. The differences lie in the greater width of black band across the breast, in the line of black edging the wings, and the orange rufous on the abdomen. The female resembles the female of *Pachycephala soror,* found also among the Arfak Mountains. This bird is olivebrown above, wings and head darker. The under surface is a bright yellow, omitting the grayish wings and dull thighs. Like her mate, the throat and chin are white. The male *P. soror* is unmarked by the yellow nuchal collar but is not without the black crescent. A bright yellow covers the breast and abdomen. The head is black, the tail dusky. Total length about 6 inches.

There are several other species of *Pachycephala* resident in Papua, almost all bearing a greater or less resemblance to each other. Among these may be mentioned without detailed description, *P. hyperythra* from Southeastern New Guinea whose under parts are of the warm reddish color that gives it its specific name.

P. albispecularis, from the Arfak region, is another species—a somewhat larger bird than its kind, gray and dark brown in general coloring with white markings on the wings.

Still another is *P. griseiceps* or *virescens,* with local differences, a bird of the average length, somewhat diversified plumage and a mottled head.

Smaller than the foregoing but with throat and chest crescent more distinctly outlined, is *P. leucogaster,* collected in the Motu country. *P. leucostigma,* from the northeast, is considerably mottled, with much rufous on the under parts, the usual white in this instance somewhat discolored, on the throat, and much streaked on the mantle.

Pachycephala fortis has its habitat in the Astrolabe Mountains, though found probably elsewhere in New Guinea. Its total length is nearly 7 inches, colored almost entirely above dark olive, below ashy gray. The head and mantle are dark gray, the tail dusky, the back and wings greenish olive. On the face are gray shadings. White prevails on the abdomen, passing into yellow. The under wings do not differ from the uniform cloudiness but are, if anything, even duller than the body.

Pachycare flavogrisea, set apart from *Pachycephala*, is colored a bluegray above, somewhat varied on the tail and wings by black or white edgings, while the under parts are a "deep, shining yellow, the yellow on the forehead and the sides of the head and neck being separated from the bluegray of the head by a broad dark stripe." Total length 4.5 inches.

If we look for those attractive little birds—the Titmice—in New Guinea, we shall find very few, if any, specimens. One is mentioned in the books, viz., *Xerophila leucopsis*, an Australian species, abundant in Queensland but not so numerous in Southern Papua. The little bird in question has a length of 4 inches. Its general color is brown, ashy above, whitish and yellowish beneath. Along the tail, neck and head the brown is positive; this is true also of the under wings; elsewhere, however, the colors are pale and indistinct, shading off gradually, as on the sides and breast, into a clouded white.

Several species and subspecies of the genus *Cracticus* range between Australia and New Guinea. These are Lanidine birds of good size, strong of beak, black, white or gray of color.

Cracticus quoyi, a typical representative, is one of these distributed pretty generally over North Australia and Southern Papua. It is almost entirely black and blueblack, the only variation being in the shading and lustre. The length is about 14 inches. Sexes alike.

Cracticus cassicus or *personatus* is more peculiarly insular, being confined chiefly to New Guinea and its islands.

The bird is strikingly conspicuous in its contrasted black and white. The former color covers the head and neck, throat and chest, upper wings and tail, excepting the two

middle feathers which are partially white. There are scattered markings, moreover, of black, intermingled with white on the back and wings. All else is a pure white above and beneath. The female is perhaps not of such glossy plumage and has less white on the back. She is also smaller than her mate by half an inch. Total length 13 inches.

Another species from Southeastern New Guinea, collected by Mr. Stone and others, is called *Cracticus mentalis* or *spaldingii.* This Dr. E. P. Ramsay of the Sydney Museum believes to be identical with *C. crassirostris*, a species separated by Count Salvadori from *C. quoyi*, already described, though by some regarded as one and the same. *C. mentalis* is about 10 inches long. The white is banded so as to divide the black of neck and back. Chin black.

In addition to those not very happily named birds—Eupetes—already mentioned in a previous article, two or three species may be briefly described.

Eupetes incertus is colored above a warm ruddy brown, the tail not quite so bright. White, bordered by dusky covers the throat, side face and abdomen. Over the chest and along the side body the plumage is rufous, the under tail coverts buff. Bill and feet are dark. Total length about 7 inches. The mountains of the northwest are the home of this species, as also of *Eupetes leucostictus* whose breast is flecked with white as its name indicates. This *Eupetes* is boldly colored with its chestnutbrown head and mantle, and its glossed dark green body and black wings spotted white on the coverts. Instead, however, of the usual white throat, the throat is black, although there is much white on either side. Black marks, too, lie on the face near the eye, the chin and upper breast. The lower parts are gray with a bluish tinge. The tail is black, the exterior feathers tipped with white, the middle ones oily green. The bill, feet and eye are black. Altogether this specimen is a remarkably fine one, unlike, in many respects, most of its family.

Eupetes pulcher, discovered in the Astrolabe Mountains, by Mr. Goldie, may be briefly described as differing from *E. castanotus* (AMER. NAT., No. 343, p. 634) only in having the head

a decidedly dusky shade instead of chestnut, and a narrow black edging to the throat in place of a somewhat broad band of black. Length 9 inches. Female a trifle smaller.

Eupetes ajax (Temm.) or *Cinclosoma ajax*, as Dr. Sharpe prefers to call it, classing it as distinct from the *Eupetes*, is a thrushlike bird about the same size as the foregoing. The general color above is a dull brown, becoming darker near and upon the tail and wings. The wing coverts, however, are a shining black; the same is true of the exterior tail feathers, excepting their ends. About the head also there is considerable glossy black which runs down the sides of the neck and becomes the sole color of the throat and upper breast.

White, which appears on the face, is seen on the underparts sometimes rimmed with a streak of black, as on the breast and abdomen, sometimes intermixed with it as on the tail and wing coverts. The sides of the body are of a ruddy tinge.

The general color of *Eupetes nigricrissus* above, including the tail and wings, is bluish, becoming dark, almost black towards the wing extremities, with bluish margins. On the face, especially about the eye there is much black; a band of the same runs around the neck, bordering the pure white throat. White spots the cheeks, also enclosed by black. The under parts are a slate color, with a bluish cast; this is true as well of the tail and under wing. Length 8 inches. The female is similar though a little smaller. The male lacks the clear stripe of white above the eye, which the female possesses. Habitat, Southeastern New Guinea.

Of the *Drymoedus*, a group allied with the *Eupetes*, a species named *Drymoedus beccarii* is the inhabitant of Southern New Guinea and the neighboring islands. The color of this pretty bird is a warm brown above, the head darker, the wings pale brown and black with white tips. The tail is similarly marked. White and black markings diversify the side face about the eye. The rest of the face and throat are clear white. The under parts are a buff, more or less variable; the crissum a dark brown. As on the wings above, so below the coloration contains bars of white in addition to the dusky brown. The bill is black. The length is about 7 inches.

Another bird of kindred species and not very unlike in plumage is *Orthonyx novæguineae.* In this case, however, the white on the under surface is far more extended. This hue is intruded upon by brown and black. The white above is less developed.

Pomatorhinus isidorii of the same family does not differ greatly in appearance. It is rather longer than the preceding and of a prevailing brown or russet, shaded more or less. Its length is about 8 inches. The female is like the male, perhaps a trifle larger in size.

A much smaller genus of birds is *Crateroscelis*, represented in New Guinea by two species, *C. murina* and *C. monarcha.* Here the ground color is still brown, brighter on the tail, darker on the head. Even the throat which is white is slightly tinged. So, too, the abdomen and lower parts generally. Total length 4.5 inches. The latter species has more white upon the under body, otherwise is mainly like the preceding.

RECENT LITERATURE.

Murray's Introduction to the Study of Sea-Weeds.[1]—In this work from the press of Macmillan & Co., George Murray has given us a book which will be of much service to those beginning the study phycology. The introduction treats briefly of the history of phycology, of the geographical and littoral distribution, and the structure of sea-weeds, and there is appended thereto some valuable information on the collection and preservation of material. Following the introduction there is given a well selected list of eighty books and papers on phycology. The book is illustrated by eight full paged colored plates—four on the red, two on the green and two on the brown sea-weeds—and eighty-eight figures in the text. The figures in the colored plates are somewhat crowded, and the specimens figured are in some cases rather

[1] An Introduction to the Study of Sea-weeds, by George Murray, F. R. S. E., F. L. S., Keeper of the department of Botany, British Museum. With eight colored plates and eighty-eight other illustrations. London, Macmillan & Co., and New York, 1895, 271 pp., 12 mo.

fragmentary, but the figures in the text are very good. Most of them having been taken from the recent works of Retuke, Solms-Lauback and the author.

Five sub-classes are recognized, i. e., *Phæophyceæ*, *Chlorophyceæ*, *Diatomaceæ*, *Rhodophyceæ* and *Cyanophyceæ*. The general arrangement of the book is poor; the more complex groups are treated of first and the simpler last, except in the *Rhodophyceæ*, where the reverse order is followed. The *Rhodophyceæ* moreover "present so many difficulties to be understood only after the study of other groups that the author has chosen the *Phæophyceæ* with its familiar forms of sea-wracks and tangles for the first sub-class. The *Chlorophyceæ* and *Diatomaceæ* follow naturally. The *Rhodophyceæ* next make a series by themselves, and finally, come the simple *Cyanophyceæ*. In the *Phæophyceæ* seventeen orders are recognized which are the same as those of Kiellman in Engler and Prantl's *Pflanzenfamilien* with a few exceptions. *Spermatochnus* is placed in the *Sporochnaceæ* and *Myriotrichia* in the *Elachistaceæ* instead of each standing in an order by itself; the *Dictyoteæ* are placed between the *Cutlereaceæ* and *Tilopteridaceæ* instead of being left out altogether; the *Ralfsiaceæ* are placed near the *Sphacelariaceæ* instead of near the *Laminariaceæ* as they have been by Kiellman and others. *Splachnidium*, a monotypic genus found only in the southern oceans, which has until recently been included among the *Fucaceæ*, is placed in an order by itself—the *Splachnidiaceæ*. It has been found that the conceptacles of *Splachnidium* contain sporangia similar to those of the *Laminariaceæ* instead of oospores and antheridia, hence it is placed near that order. The marine *Chlorophyceæ* are treated under eleven orders; many recent facts as to their reproduction being incorporated. At the end of two groups, the *Perecllneæ* and the Coccospheres and Rhabdospheres are briefly mentioned as being on the borderland between the vegetable and animal kingdom. In the twenty pages devoted to the *Diatomaceæ*, the structure, reproduction, geographical and geological distribution are quite fully discussed, but nothing is said of the arrangement of the groups and very little of its systematic position. We can agree with the author that the diatoms should not be placed in the *Phaeophyceæ* solely because they have a coloring matter closely related to that of the brown sea-weeds, but we can hardly agree that a siliceous covering and the presence of diatomine are sufficient to separate so widely two groups otherwise so closely related as the diatoms and desmids.

According to the preface "the account of the *Rhodophyceæ* is based on the scattered papers of Schmitz, who by utilizing his own researches

and the splendid investigations of Thuret and Bornet, has almost wholly altered the classification of the sub-class." Four orders are recognized, based upon the development of the cystocarp; the *Menaliomaceæ, Gagartinaceæ, Rhodomenaceæ, Cryptonemiaceæ.* The *Bungiaceæ*, including *Perphyra,* are placed at the end of the *Rhodophyceæ* as an *Anhang.* In the last ten pages the *Cyanophyceæ* are briefly treated under two orders, the *Nostocaceæ* and *Clerocaccaceæ.* Throughout the work each order and in the larger orders each family is synoptically treated under four heads; general character, thallus, reproduction and geographical distribution. In it are embodied the results of the latest investigation on all groups, much having been taken from the able investigations of the author and his associates. Errors are comparatively few, one of the most noticeable being the mentioning of genus *Egregia* as one of the Fucaceae (P. 55). It is again mentioned in its proper place among the *Laminariaceae* (P. 85).

DE ALTON SAUNDERS.

Taxonomy of the Crinoids.—The true position of a science in the scale of progress is measured by the degree of perfection exhibited in the systematic arrangement of the phenomena of which it treats. Its claims to philosophic recognition are proportional to the accuracy of the genetic relationships shown in its system of classification. If this be true of a general science, it is no less a reality in its various departments. There is, perhaps, nowhere a better exemplification than the Crinoids; and no zoological group has made in recent years more rapid progress towards a rational classification.

The data upon which the systematic arrangement of the stemmed echinoderms rests are elaborately set forth in the lately issued work of Messrs. Charles Wachsmuth and Frank Springer.[2] It is of great interest to know that the advancement in an understanding of the group has been almost wholly from the paleontological side and that the results are accepted practically without change by the most eminent students of the living forms. As is well known, the crinoids are to-day almost extinct; but that in past geological ages they were the most prolific forms of life. On account of the peculiar construction, unusually great opportunities are afforded for the solution of morphological problems, and full advantage has been taken. Upon so firm a foundation does the classification of the crinoids, as prepared by Wachsmuth and Springer now rest, that it is hardly probable that it will require radical change for a century to come.

[2] North American Fossil Crinoidea Camerata: Memoirs Museum Comp. Zool., 2 parts, 800 pp., and atlas of 83 plates. Cambridge, 1895.

As regards the major subdivisions of the stemmed echinoderms three groups are recognized: the cystids, the blastoids, and the crinoids. These are considered as groups of equal rank. The forms of the first are earliest in time, lowest in taxonomic position, and are regarded as the ancestral types of the other two. The crinoid type itself is a very old one, dating from the Cambrian in which it is even then in a high stage of development. During the Ordivician the cystidian features had almost wholly disappeared. The crinoidal group is remarkable for the persistence it has shown in preserving its pentamerous symmetry; and although the introduction of the anal plate so disturbed it as to well nigh produce a permanent bilateral arrangement, the former was finally permanently retained.

Neocrinoidea and Palæocrinoidea, the two primary groups of crinoids which were formerly almost universally recognized, are abandoned. In their stead are recognized three principal subdivisions: Inadunata, Camerata and Articulata. It is quite remarkable that this ternate grouping of the crinoids is essentially the same as Wachsmuth originally proposed more than twenty years ago, and that often being compelled by students of the recent forms to abandon it and to substitute others, a careful survey in the light of recent discoveries of all crinoids both fossil and living has clearly shown that the main subdivisions first suggested are essentially valid and are applicable to all known forms. The criteria for separating the crinoids into orders are briefly as follows:

1. Condition of arms, whether free above the radials or partly incorporated in the calyx.

2. Mode of union between plates of the calyx, whether movable or rigid.

3. Growth of stem, whether new plates are formed beneath the proximal ring of the calyx or beneath the top stem joint.

The simplest forms, the Crinoidea Inadunata, have the dorsal cup composed invariably of only two circlets of plates or three where infrabasals are present; there are no supplementary ossicles except an anal piece, which is, however, not always present; the arms are free from the radials up. In the construction of the ventral disk two different plans are recognizable, and upon these are established two sub-groups, the Larviformia and Fistulata. The former has the disk in its simplest possible form, being composed of five large orals arranged in a pyramid; the second has the ventral side extended into a sac or closed tube often reaching beyond the ends of the arms.

The Camerata are distinguished by the large number of supplementary pieces which bring the proximal arm plates into the calyx, thus enlarging the visceral cavity; all plates are heavy and immovable; the mouth and food grooves are tightly closed.

The Articulata have to some extent the incorporation of the lower arm plates with the calyx, but the plates are movable instead of rigid. The mouth and food grooves are open. The infrabasals are fused with the top stem joint which is not the youngest plate of the stalk. According to whether or not pinnules are present two suborders are recognized: the Pinnata and Impinnata.

An analytical synopsis of the families of Camerata as proposed by the authors and as now understood is as follows:

I. Lower brachials and interbrachials forming an important part of the dorsal cup.

A. INTERRADIALS POORLY DEFINED.

The lower plates of the rays more or less completely separated from the primary interradials by irregular supplementary pieces; dicyclic or monocyclic — RETEOCRINIDÆ.

B. INTERRADIALS WELL DEFINED.

1. Dicyclic.

a. Radials in contact except at the posterior side — THYSANOCRINIDÆ.

b. Radials separated all around — RHODOCRINIDÆ.

2. Monocyclic.

a. Radials in contact all around.

Symmetry of the dorsal cup, if not strictly pentamerous, disturbed by the introduction of anals between the brachials only — MELOCRINIDÆ.

Arms borne in compartments formed by partitions attached to tegmen; dorsal cup perfectly pentamerous; plates of calyx limited to a definite number — CALYPTOCRINIDAE.

b. Radials in contact except at the posterior side, where they are separated by an anal plate.

First anal plate heptagonal, followed by a second between two interbrachials — BATOCRINIDAE.

First anal plate hexagonal, followed by two interbrachials without a second anal, arms branching from two main trunks by alternate bifurcation — ACTINOCRINIDAE.

II. Brachials and interbrachials slightly represented in the dorsal cup.

1. DICYCLIC,

Radials in contact except at the posterior side — CROTALOCRINIDAE.

2. MONOCYCLIC.

a. Radials in contact all around; base pentagonal — PLATYCRINIDAE.

b. Radials separated at posterior side by an anal plate; base hexagonal.

Basals directly followed by the radials — HEXACRINIDAE.

Basals separated from radials by accessory pieces — ACROCRINIDAE.

Regarding the terminology employed, special attention should be called to the clear and concise definitions given of the various structural parts. The terms should be universally adopted, and they form

by far the best collection ever proposed. American writers especially will need no appeal to at once use them, not only in order to secure uniformity in nomenclature but to insure precision of description. Heretofore the names of the various plates or groups of ossicles have been used in a rather haphazard way. Not only have different designations been given to the same part but the same title has been repeatedly applied to structures widely separated morphologically.

CHALES R. KEYES.

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General Notes.

PETROGRAPHY.[1]

Examples of Rock Differentiation.—Yogo Peak in the Little Belt Mountains, Montana, consists of a stock of massivei gneous rock which breaks up through surrounding horizontal sediments, that have been metamorphosed on their contact with the eruptive. A vertical section through the south face of the mountain caused by a branch of Yogo Creek has afforded Weed and Pirsson[2] and excellent opportunity to study the relations of different phases of the eruptive to one another. The massive rock shows a constant variation and gradation in chemical and mineralogical composition along its east and west axis which is two miles in length. In its eastern portion the rock is a syenite, containing pyroxene, hornblende, biotite, orthoclase, oligoclase, quartz and a few accessories. The pyroxene is a pale green diopside and the hornblende a brownish-green variety. The latter is thought to be paramorphic after the former. In structure the syenite is hypidiomorphic with a

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.

[2] Amer. Journ. Sci., Vol. L, 1895, p. 467.

tendency toward the allotriomorphic structure. Further west, about in the center of the mass, the syenite changes to a darker gray rock with a tinge of green, somewhat resembling a diorite. It is more coarsely crystalline than is the syenite and is much more basic. The minerals are the same as in the syenite, except that quartz is lacking, but differ somewhat in their character and in the proportions present in the two rocks. The augite is now a bright green idiomorphic mineral. Hornblende is rare and biotite abundant. The great difference between this rock, which the authors call yogoite, and the syenite, is in the relative proportions of augite and orthoclase present in them. In the yogoite the pyroxene predominates over the orthoclase, while in the syenite the reverse ratio exists. In the western portion of the rock mass, the prevailing type is shonkinite, a very dark basic rock, very similar to that of Square Butte.[3] Augite and biotite are very abundant as compared with the orthoclase, which in turn predominates over plagioclase. This latter mineral is represented by andesine, a more basic feldspar than that in either the syenite or the yogoite. Analyses of the three types of Yogo Peak rocks follow:

	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	Fe_2O_3	FeO	MnO	MgO	CaO	BaO	SrO	Na_2O	K_2O	H_2O	P_2O_5		Total
Syenite	61.65	.56	15.07	tr	2.03	2.25	.09	3.67	4.61	.27	.10	4.35	4.50	.67	.33	=	100.15
Yogoite	54.42	.80	14.28	tr	3.32	4.13	.10	6.12	7.72	.32	.13	3.44	4.22	.60	.59	=	100.19
Shonkinite	48.98	1.44	12.29	tr	2.88	5.77	.08	9.19	9.65	.43	.08	2.22	4.96	.82	.98	=	99.77

Shonkinite contains in addition .22 per cent. of Fl.

From a consideration of the nature of the three types of rock the authors conclude that the Yogo Peak stock exhibits the results of a progressive differentiation along its major axis. There is a progressive increase in the ferro-magnesian constituents from the east to the west and a consequent increase in basicity. All the components of the three types exhibit the effects of this differentiation in the proportions present in the different rocks. The Yogo Peak mass is thus an illustration of a "Facies suit" as distinguished from a "rock series." In the former differentiation took place in situ, whereas in a 'rock series' differentiation occurred before the eruption of rocks into their existing positions. The facies suit of Yogo Peak together with the rocks of neighboring mountains comprise a distinct rock series.

The authors close their paper with an appeal for a more specific nomenclature in petrography—a nomenclature that will take account not only of the qualitative relations between the minerals that make up rock masses but of the quantitative relations as well. The Yogo Peak

[3] Compare American Naturalist, 1895, p. 737.

rocks form a natural series with sanidinite and peridotites. Rocks composed of orthoclase and no augite = sanidinite; when orthoclase exceeds augite = augite-syenite; when orthoclase equals augite = yogoite; when augite exceeds orthoclase = shonkinite; when augite alone is present = pyroxenite and peridotite. In this scheme the term augite includes also other ferro-magnesian minerals, and the terms orthoclase other feldspars.

In connection with the article above referred to Iddings[4] mentions the existence of a series of rocks associated with typical basalts and andesites in the Yellowstone National Park. They represent like phases of differentiation belonging to separate, but similar rock families. Most all of these rocks are basaltic looking. They occur in flows and dykes and sometimes as breccias, constituting the major portion of the Absaroka Range. These rocks present a wide range of composition within definite limits, forming a series connected by gradual transitions. Three classes are distinguished, the first of which is characterized usually by abundant phenocrysts of olivine and augite and an absence of feldspar phenocrysts; the second class is characterized by the presence of labradorite phenocrysts in addition to those of olivine and augite, and the third class by the presence of labradorite phenocrysts. The names given to the three classes are absarokite, shoshonite and banakite. The distinctions between the classes is based principally upon their chemical relationships. A large number of analyses, most of which were taken from other papers, illustrate their points of difference. A comparison of the analyses, besides showing the close relationships existing between the rocks of the three classes, shows also what mineralogical differences may obtain for rocks of the same chemical composition. The shoshonite from the base of Bison Peak and the banakite from Ishawooa Canyon have practically the same chemical composition. The former, however, contains abundant phenocrysts of labradorite, augite and olivine, while the latter contains numerous labradorite phenocrysts, but few and small ones of the other two minerals. The groundmass of the first shows much less orthoclase than that of the second, and no biotite, which abounds in the second. The author compares the series of rocks studied by him with the series studied by Merrill[5], with the series discussed by Weed and Pirsson and with Brögger's[6] grorudite-tinguaite series. The conclusion reached by this comparison is to the effect that it may be doubted whether the gen-

[4] Journal of Geology, Vol. III, p. 935

[5] Cf. American Naturalist, 1896, p. 128.

[6] Cf. American Naturalist, 1895, p. 567.

etic relations between igneous rocks can properly mark the lines along which a systematic classification of them may be established.

Petrographical Notes.—In a phyllite-schist found in blocks on the south shore of Lake Michigamme in Michigan, Hobbs[7] has discovered large crystals of a chloritoid like that described by Lane, Keller and Sharpless in 1891. The rock in which the crystals occur is a mass of colorless mica scales through which are distributed large flakes of biotite, small blades of chloritoid, a few acicular crystals of tourmaline and grains of magnetite. Most of the chloritoid is in large porphyritic crystals imbedded in this matrix. The optical properties of the mineral correspond to those of masonite.

In a summary of the results of this work in the upper Odenwald Chelius announces the existence there of two granites—the younger a fine grained aplitic variety and the older a coarse grained porphyritic variety, with a parallel structure due to flowage. Pegmatitic veins that cut this granite are looked upon as linear accumulations of porphyritic feldspar crystals. Many notes are also given on the diorites, gabbros and basalts of the Odenwald, on the basic enclosures in the granite, which the author regards as altered fragments of foreign basic rocks, but nothing of a startling nature with reference to these subjects is recorded. A gabbro porphyry was found occurring as a dyke mass. It consists of phenocrysts of labradorite in a gabbro-aplitic groundmass.

In a general paper on the divisibility of the Laurentian in the Morin area N. W. of Montreal, Canada, Adams[8] describes the characteristics of the members of the Grenville series of gneisses, quartzites and limestones. The augen gneisses, the thinly foliated gneisses and the granulites of the series are all cataclastic or granulitic in structure. They are regarded as squeezed igneous rocks. The crystalline limestones and quartzites are recrystallized rocks that are thought to be changed sedimentaries. Pyroxene gneisses, pyroxene granulites and other allied rocks are of doubtful origin. In addition to all these rocks there is present in the series a group of peculiar banded garnetiferous gneisses which from their chemical composition are regarded as in all probability metamorphosed sedimentary rocks.

[7] Amer. Jour. Sci., Vol. L, 1895, p. 125.
[8] Amer. Jour. Sci., Vol. L, 1895, p. 58.

GEOLOGY AND PALEONTOLOGY.

The Paleozoic Reptilian Order Cotylosauria.—A paper was read before the American Philosophical Society, November 15, 1895,[1] by Prof. E. D. Cope, on the reptilian order Cotylosauria. The following is an abstract of the characters of the order.

Quadrate bone united by suture with the adjacent elements. Temporal fossa overroofed by the following elements: Postfrontal, postorbital, jugal, supramastoid, supratemporal, quadratojugal. Tabular bone present. Vertebræ amphicoelous; ribs one headed. Episternum present. Pelvis without obturator foramen.

This order is of great importance to the phylogeny of the amniote Vertebrata. The structure of the temporal roof is essentially that of the Stegocephalous Batrachia, while the various postorbital bars of the amniote Vertebrata are explained by reference to the same part of its structure.

The palatal elements in this order are more or less in contact on the middle line, and the pterygoids diverge abruptly from this point, and return to the quadrate. The occipital condyle is single, and does not include exoccipital elements (unknown in Elginia).

Intercentra are present in Pariasauridæ, Diadectidæ and Pariotichidæ, and they are wanting in Elginiidæ. The hyposphen-hypanterum articulation is present in the Diadectidæ, but is wanting in the Elginiidæ and Pariasauridæ.

The scapular arch is best known in Pariotichidæ, Pariasauridæ[2] and Diadectidæ. In the two former there is a T-shaped episternum, over which are applied the median extremities of the clavicles; and there are well-developed coracoid and praecoracoid. In Diadectidæ[3] (probably genus Empedias) the episternum is articulated by suture with the clavicles.

In the Proceedings of the American Philosophical Society, 1892, p. 279, in a paper on "The Phylogeny of the Vertebrata," I wrote as follows: "Moreover, the Pelycosauria and the Procolophonina have the interclavicle, which is an element of membranous origin, while in the Prototheria we have the corresponding cartilage bone, the episternum. This element is present in the Permian order of the Cotylo-

[1] See Proceedings Amer. Philos. Soc., Vol. XXXIV, 1896, p. 436.

[2] Seeley, Philos. Trans. Roy. Soc. London, 1888, p. 89; 1892, p. 334.

[3] Cope, Proceeds. Amer. Philos. Soc., 1883, p. 635.

sauria which is nearly related to the Pelycosauria." The examination of the sternal region in Pariotichus has led me to the conclusion that the episternum and interclavicle are present and fused together in that genus, and also to the belief that the episternum is present in the genus Procolophon. The structure is generally similar in the two genera, and I think that Seeley is in error in determining the element in question in Procolophon as the interclavicle only.[4] Gegenbaur pointed out in his *Comparative Anatomy* the different (*i. e.*, membranous) origin of the interclavicle of the Lacertilia, but he included it with the episternum under the same name. The true episternum is not present in the Lacertilia. It is present in the Sauropterygia and Testudinata and probably in all the orders with one postorbital bar, or Synaptosauria, while it is wanting in most or all of the Archosaurian series, and in the Squamata. Whether the element I have referred to in the genus Naosaurus as interclavicle, is that element or the episternum, must remain uncertain until I can see it in place. Its edges are thin, as in the interclavicle of the Lacertilia. Of course, the Reptilian order which is in the line of ancestry in the Mammalian will have an episternum and not an interclavicle only. The Stegocephalia among Batrachia possess an episternum, with, perhaps, an adherent interclavicular layer as in the Testudinata.

Seeley describes four sacral vertebræ in Pariasaurus. In Empedias there are but two. The pelvis is without obturator foramen. The humerus has an entepicondylar foramen. The tarsal and carpal elements are incompletely known.

There are palatine teeth in Empedias and Pariasaurus, but none in Elginia; vomerine teeth none.

The inferior surface of the cranium is known in Elginia, Pariasaurus, Empedias and Pariotichus, and has been described as to the first three genera by Newton, Seeley, and myself. Pariotichus displays generally similar characters. There is a pair of posterior nares, and a pair of zygomatic foramina, but no palatine foramen. The palatine elements meet on the middle line, but gape behind. The vomers (prepalatines) are distinct, and are well developed anterior to the palatines. The ectopterygoid is large and has a prominent posterior border. I have stated that in Empedias there are teeth on the vomer. Better preserved specimens of Pariotichus show that the teeth are really borne on the edges of the palatines, which are appressed on the median line in the former genus. Similar palatine teeth are present in Pariasaurus, but are wanting in Elginia. Teeth are also present on the posterior

[4] Philos. Transac. Royal Society, 1889, p. 275, Pl. IX, fig. 9.

edge of the ectopterygoids in Pariasaurus and Pariotichus, but not in Elginia or Empedias. A character of the American genera is the weakness of the attachment of the basioccipital to the sphenoid. The basioccipital is lost from the only known specimen of Elginia, and the sphenoid projects freely below it in Pariasaurus, The roof of the mouth in this order is a good deal like that of the Lacertilia, lacking the palatine foramen.

The order Cotylosauria was defined by me in the AMERICAN NATURALIST for 1880, p. 304, and in 1889 (October). In 1889 (Transac. Roy. Soc. London, p. 292), Prof. Seeley gave it the name Pariasauria. In my *Syllabus of Lectures on Vertebrate Paleontology* (1891, p. 38), I arranged the group as a suborder of the Theromora. In 1892 (*Trans. Amer. Philos. Soc.*, p. 13, Pl. I), I again regarded the Cotylosauria as an order, and described the characters of the skull in three of the genera, and gave figures of them.

Seeley has objected to the reference of the genera Pariasaurus and Empedias to the same order, on the ground that the elements connecting the supraoccipital and the quadrate rest on the occipital elements in the latter, while they are elevated above them in the former. This character would not, however, define orders, as both conditions are found in Lacertilia; but might distinguish families within an order. However, Seeley's description and figure of the occipital region in *Pariasaurus bainii*[5] show that the structure only differs from that of the Diadectidae in the presence of a large foramen between the supraoccipital and exoccipital bones on each side.

The known species of the Cotylosauria range in dimensions from that of the South American Caimans (Chilonyx, Pariasaurus sp.) to that of the smaller Lacertilia, e. g., *Eumeces quinquelineatus* (Isodectes and Pariotichus sp.). They range from the Coal Measures to the Trias, inclusive, and have been found in South Africa, North America and Scotland. A single genus has been found in the Coal Measures of Ohio, which is represented by a species which I called *Tuditanus punctulatus*.[6] It is of small size, and as the maxillary teeth are of equal length, I cannot distinguish it from Isodectes, which belongs to the Pariotichidæ. The other species which were referred to Tuditanus are Stegocephalia.[7] *This is the first identification of a true reptile in the Coal Measures.*

[5] Philos. Transac. Roy. Soc. 1892, p. 326, Pl. XVIII, Fig. 2.

[6] Transac. Amer. Philosoph. Society, April, 1874, separate p. 11. Report Geol. Survey of Ohio, 1875, Paleontology, p. 302, Plate XXIV, fig. 1 (erroneously named in explanation *Tuditanus longipes*).

[7] Proceeds. Amer. Philos. Soc., 1871, p. 177.

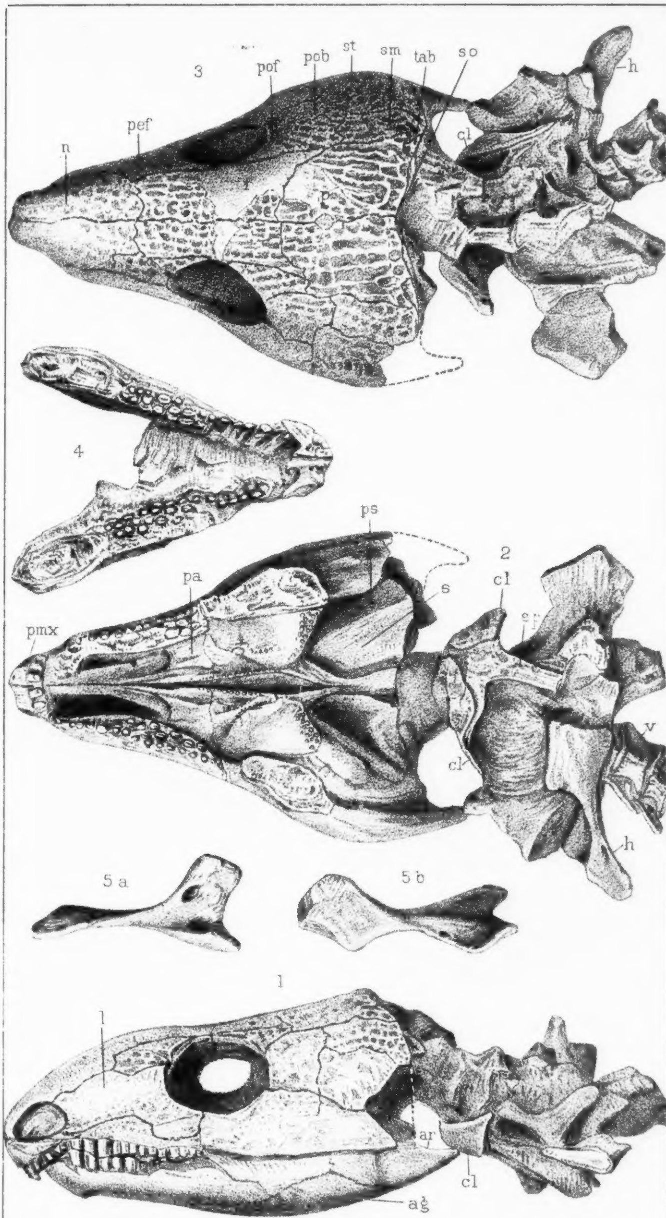
This order embraces, at present, four families, comprising 24 species distributed among 12 genera, as follows: Elginiidae, 1 genus, 1 species; Pariasauridæ, 3 genera, 7 species; Diadectidæ, 5 genera, 9 species; Pariotichidæ 6 genera (of which 3 are new, viz.: Isodectes, Captorhinus and Hypopnous), and 12 species, of which 5 are new. Total, 29 species, 15 genera.—E. D. Cope.

EXPLANATION OF PLATE VIIa.

Pariotichus aguti Cope. From the Proceeding Amer. Philos. Society, November, 1895. Fig. 1, Skull, from side. Fig. 2, Skull, with angular parts of mandible adherent, cervical vertebrae and scapular arch, from below. Fig. 3, Skull, from above, with cervical vertebrae. Fig. 4, Anterior two-thirds of mandibular arch, with adherent premaxillary bones, from above. Fig. 5, Humerus. *N.*, Nasal bone; *F.*, Frontal; *Pef.*, Prefrontal; *Pof.*, Postfrontal; *P.*, Parietal; *Pmx.*, Premaxillary; *Mx.*, Maxillary; *J.*, Jugal; *Qj.*, Quadratojugal; *St.*, Supratemporal; *Sm.*, Supramastoid; *Tab.*, Tabulare; *So.*, Supraoccipital; *V.*, Vomer; *Pa.*, Palatine; *Par.*, Paroccipital; *Ecp.*, Ectopterygoid; *Ps.*, Pterygoid; *Q.*, Quadrate; *Ce.* Clavicle; *Ep.*, Episternum; *H.*, Humerus.

The Puget Group.—Sir Wm. Dawson confirms the opinion advanced by Dr. G. M. Dawson in 1890 that the formation in the north-western part of the United States to which the name Puget group has been given, extends into British Columbia as far as Burrard's Inlet. This great estuarine deposit extends southward as far as the Columbia River and from the coast line to the Cascade range, within which its beds rise to a height estimated at from 800 to 5000 feet above the level of the sea. They overlie the Cretaceous Chico series in the United States, and its equivalent the Nanaimo formation in Canada. The latest views of paleobotanists and geologists of the United States seem to be that these beds are of Eocene age and that the fossil plants may be best compared with those of the Upper Laramie of the interior plains. In so far as Canada is concerned it has been established that the Upper Laramie beds underlie a formation containing animal fossils of the White River Miocene period, so there can be no doubt as to their Eocene age, and consequently of the Eocene age of the Puget group in Canada.

A further confirmation as to this view of the age of the formation in question is found in a collection of fossil plants from the vicinity of Burrard Inlet. These were referred to Sir Wm. Dawson for identification who sums up the results of his study as follows:



PARIOTICHUS AGUTI COPE.

"A comparison with the flora of the Upper Cretaceous Nanaimo series shows that the Burrard Inlet species are distinct and of more modern aspect. On the other hand, they are also distinct from those of older Miocene deposits of the Similkamen district and other parts of the interior of British Columbia. Between these they occupy an intermediate position; in this resect corresponding with the Laramie of the interior plains east of the Rocky Mountains. They also resemble this formation in the general facies of the flora, which is not dissimilar from that of the Upper Laramie or Fort Union group."

"We may thus refer these plants to the Paleocene or Eocene, and regard them as corresponding with those of the Atanékerdluk beds in Greenland, the lignitic series of the McKenzie River, and the beds holding similar plants in Alaska."

"This flora thus serves to fill the gap in our western series of fossil plants, namely, that between the Cretaceous and the Lower Miocene." (Trans. Roy. Soc. Can. (2), Vol. I, 1895–'96.)

The Geological Structure of Florida is according to Prof. E. T. Cox, remarkable for its simplicity. The underlying rock is a soft limestone of Upper Eocene age; resting on this are beds of phosphate of lime; and covering the phosphate and limestone is a bed of sand that varies from a few inches to 20 feet and more in depth.

The Eocene limestone is filled with fossil marine shells. It shows no evidence of disturbance and is without a trace of stratification. It has an amorphous structure and is of unknown thickness. The phosphate of lime occurs in detached masses scattered over an area about 20 miles wide, and exending in a belt, follows in general way the trend of the Gulf coast from the northern limits of the state and beyond, to the western edge of the Everglades on the south. The author believes the phosphate to be the result of the mineralization of guano.

The covering of sand is found all over the Peninsula. It has been blown by the winds from the gulf and ocean beaches. Mixed with the sand is clay in the form of fine dust. In several localities the associated clay has been separated from the sand by running water and deposited as kaolin. This kaolin has been tested and found to be of superior quality for the manufacture of the finest porcelain.

Florida is not a level plain. A ridge from 30 to 50 miles wide extends from the northern part of the state to the Everglades, having an elevation of more than 230 feet in some places. From this ridge the land slopes to the Atlantic on the east and the Gulf on the west.

The elevation of the Peninsula was due to that continental force, extended over a vast period of time, which brought the tops of the Rocky

Mountains above the waters of the Pacific. (Trans. Amer. Inst. Mining Engineers.)

The Eocene age of part of Florida was first asserted by Prof. Eugene Smith of Alabama, and this conclusion was confirmed by paleontologic data by Prof. Heilprin, of Philadelphia. Dr. W. H. Dall subsequently delimited exactly the area of these beds with the Neocene and Plistocene beds to the south, east and north of them.

Notes on the fossil Mammalia of Europe Pt. II.—*On the affinities of the Genus Tapirulus, Gervais.*—Tapirulus is one of those aberrant types, where we find a curious assemblage of characters, which to the systematist is a great annoyance, although to the morphologist most instructive.

A superficial examination of the teeth has lead some palæontologists to assign this genus a position near the Tapir. Gervais[1] established this genus on the characters of the lower true molars.[2] He referred *Tapirulus* to the family *Anoplotheriidæ*, which I shall endeavor to prove is its proper position, although this reference on his part I believe was accidental, as he placed in the same family the genus *Adapis*. Gaudry[3] has assigned *Tapirulus* a position near the genus *Tapirus*, and Zittel[4] referred it to the *Suidæ*.

Through the great kindness of Prof. Albert Gaudry, who has so generously allowed me to study so many of the beautiful specimens in the collection of the Jardin des Plantes, I have had the opportunity of examining a skull of *Tapirulus*, in which the greater part of the upper dentition is preserved. On examination of this skull I was at once struck by its close resemblance to that of *Anoplotherium*, and *Dacrytherium*.

The skull in *Tapirulus* is slender and much elongated, the dorsal contour is nearly straight, and the facial portion is strongly compressed and slender. There is no preorbital fossa, as in *Dacrytherium*, and the occiput is high and narrow, like that of *Anoplotherium*. The auditory region very closely resembles that of *Dacrytherium*, the paroccipital process is long, slender and the posttympanic and glenoid processes are applied closely to the external auditory meatus. The brain case in the *Anoplotheriidæ* is much extended anteroposteriorly, being about one-half the total length of the skull in *Dacrytherium*. In *Tapirulus* the

[1] Comptes Rend. Acad. Sci., 1850, p. 604.
[2] Zoologie et Palæontologie Francaise, p. 173, pl.
[3] Journal de Zoologie, XIV, 1875, p. 5.
[4] Traité de Palæontologie, 1894, p. 338.

cranial portion of the skull is shorter relatively than in *Dacrytherium* and with this decrease in length I observe a greater development of the anterior part of the brain case, which encloses the frontal lobes of the brain. In short the brain of *Tapirulus* as compared with the size of the skull, must have been much larger than in *Dacrytherium,* and this greater development effected especially the frontal region of the brain.

As the Suilline type of skull was well established in the Phosphorites or Upper-Eocene of France (*Cebochœrus*), I shall compare the cranium of *Tapirulus* with that of *Cebochœrus.* In the latter genus the brain case is very much reduced with the extremely prominent zygomatic arches; sagittal and lambdoidal crests are very heavy and the occiput is broader than high. The cranial portion of the skull in *Cebochœrus* is much heavier and broader than the facial. All these cranial characters in *Cebochœrus* differ decidedly from those of *Tapirulus* and I enumerate them, so as to prove that *Tapirulus* has no direct affinity with the Suillines. The skull of *Tapirulus* somewhat resembles that of the primitive Selenodonts, (*Cœnotherium*), but it is more slender and its general form more closely resembles that of the *Anoplotheridæ.*

It is, however, the peculiar structure of the teeth, which is the most important consideration in studying *Tapirulus.* It is upon the characters of the teeth that *Tapirulus* has been assigned its various positions in the Ungulata. On a superficial examination of the upper true molars of *Tapirulus,* they exhibit a certain resemblance to those of the Tapir, but studied in detail I shall endeavor to prove that the molars of *Tapirulus* differ fundamentally in their plan from any of the known Lophiodonts. In the first place the external lobes of the superior molars in *Tapirulus* are concave, and not convex as in the true Tapirine molar. Again the transverse crests are straighter and their relation to the external lobes differ from those of the Tapirs tooth. At the junction of the transverse crests and the external lobes there is a strong notch, and in one specimen I can detect a faint trace of the intermediate tubercles.

The superior molars of the *Anoplotheriidæ.* as is well known, have deeply concave external lobes, the protoconule is distinct from the protocone, the latter element being in its primitive bunodont condition. In *Anoplotherium* and *Dacrytherium* the hypocone is selenodont in structure. In other words the form of superior molar found in the *Anoplotheridæ* is a slight modification of the buno-selenodont type, it differs from the exact form of this type in having the hypocone crescentoid.

Now in *Tapirulus* the two external concave lobes of the superior molars have nearly the same structure as those of *Dacrytherium*, and the internal primitive bunodont elements of the crown, have been transformed into crests, this occurred before the *Anoplotherium* type of molar had reached its present stage of evolution. It is then not difficult to derive the form of superior molar found in *Tapirulus* from the true buno-selenodont type, and I believe this to have been the origin of the peculiarly modified molar occurring in *Tapirulus*.

The superior and inferior premolars in *Tapirulus* have the same elongated form so characteristic of the *Anoplotheriidæ* in general, and like the latter group, the canines were not differentiated in form from the anterior premolars. The lower true molars of *Tapirulus* depart widely in structure from those found in any of the known genera of the *Anoplotheridæ*, although like the upper molars they are much specialized and can be derived from a less modified type, which was the common stock of both *Tapirulus* and *Anoplotherium*. A peculiarity in the structure of the lower molars of *Tapirulus* is the presence on each tooth of a well developed third lobe, hypoconulid, which projects posteriorly a considerable distance. The portion of the molar crown anterior to the hypoconulid consists of two high transverse crests, the antero-external termination of the front crest exhibiting a rudiment of the anterior spur, which is so largely developed in all the other genera of the *Anoplotheridæ*. The lower jaw in *Tapirulus* is long and extremely slender and its form closely resembles that of *Dacrytherium*.

In conclusion I believe the natural position of *Tapirulus* is in a subfamily of the *Anoplotheriidæ*, and that both *Tapirulus* and *Anoplotherium* have been derived from a common stock, the ancestral form having had the pure type of buno-selenodont molar. As already shown above, the resemblance in structure of the molars of *Tapirulus* to that of the Tapir is not exact, the Tapirs tooth having been derived direct from the bunodont type (See *Euprotogonia* and *Systemodon*).

III.

On the validity, and systematic position of Mixtotherium Filhol.—The genus *Mixtotherium*[5] is another interesting form, not as aberrant in its characters as *Tapirulus*, but which unites in a certain degree the Suillines and the Anoplotheroids. Prof. Zittel in his "Traité de Palæontologie" does not consider *Mixtotherium* as a good genus, and refers it to the milk dentition of *Diplobune*. I am quite confident that Prof. Zittel is mistaken in this determination, and I shall endeavor to

[5] Mém. quelques Mam. fossiles, Toulouse, 1882.

prove that *Mixtotherium* is a valid genus and entirely distinct from either *Diplobune* or *Dacrytherium.*

The genus *Adiotherium* was described by Filhol in 1884. This genus is referred by Zittel to the milk dentition of *Dacrytherium*, I can not agree with Prof. Zittel on this reference either, as I believe *Adiotherium* to have been based upon the milk dentition of *Mixtotherium.*

The skull in *Mixtotherium* is essentially Suilline, but exhibiting some characters like those of the Anoplotheroids. The form of the brain case is longer and narrower than in *Cebochœrus*, and it closely resembles that of *Acotherulum* which is one of the most primitive of the early Suillines of Europe. The occipital region of the skull in *Mixtotherium* is much broader than high, and is not constricted in the middle as in *Dacrytherium;* the occiput has nearly the exact form of *Acotherulum* and *Cebochœrus.*

In the primitive pigs of the Phosphorites the auditory bullæ are extremely small, in *Mixtotherium* they are large. The basioccipital region of the skull in *Mixtotherium* is rather long and narrow, and like that of *Dacrytherium.* In *Cebochœrus* of the Phosphorites, the peculiarly elongated and constricted snout of the pigs is well differentiated, however, in *Mixtotherium* as well as *Acotherulum* the facial region of the skull is broader and shorter, its form being more as in *Dacrytherium. Mixtotherium* agrees with *Diplobune* and differs from *Dacrytherium* in lacking a preorbital fossa in the maxillary bone. The general form and proportions of the skull in *Mixtotherium* is very much like that of the peculiar American genus, Oreodon.

The dentition of *Mixtotherium* resembles that of the *Anoplotheridæ* in the absence of any diastemas, it differs, however, from this family in the large size of the canines, which in form resembles more those of the Suillines. The superior premolars are normal in form, and not elongated as in the Anoplotheroids. The last upper premolar closely resembles in structure a true molar, it has two external cusps, which are intermediate in structure between the bunoid and selenoid forms. The deuteroconid forms a crest with the antero-intermediate tubercle, the tetastoconid is present, but small and bunoid in structure. The structure of the superior molars of *Mixtotherium* differ from those of *Diplobune* and *Dacrytherium* in the following details; the external crescents are united externally by a prominent mesostyle, which is more constricted than in *Diplobune;* in *Dacrytherium* this portion of the molar is open widely internally.

In the *Anoplotheridæ* the protocone is distinct from the protoconule, whereas in *Mixtotherium* these elements are united and form a well

developed protoloph. In *Mixtotherium* the hypocone is selenoid in structure as in *Dacrytherium*, but this cusp is much smaller and it is much less extended internally than in that genus. I emphasize especially the large development of the mesostyle, and the presence of a protoloph, characters of the upper molars of *Mixtotherium* which differs decidedly from those of *Dacrytherium*. The structure of the fourth upper premolar in *Mixtotherium* resembles somewhat that of *Agriochœrus*, but differs from this genus in the presence of the postero-internal cusp. In *Dichodon* Owen, the complication of the fourth upper premolar is carried still further than in *Mixtotherium*, as in *Dichodon* this tooth is completely molariform and selenodont in structure. However, I believe, that *Mixtotherium* has no close affinity with *Dichodon*, as the structure of the skull and dentition in *Dichodon* is quite modernized.

The lower jaw in *Mixtotherium* is rather short and deep below the last lower molar, these characters differ strikingly from those of the *Anoplotheriidæ*, where the jaw is very slender and elongated. The mandibulæ are strongly ankylosed at the symphysis as in the primitive pigs, *Acotherulum* and *Cebochœrus*, this is a character I believe seldom found in the Mammalia outside of the Primates. The last lower premolar in *Mixtotherium* is intermediate in structure between a last milk tooth and permanent molar. It consists of an antero-median cusp, bunoid in form, and posterior to it, of two external crescents and two flattened internal elements. The structure of the inferior true molars is like that of *Dacrytherium*.

It appears to me that the genus *Mixtotherium* is of importance phylogenetically, and demonstrates how closely the Suillines and Anoplotheroids are related. In the characters of the skull and the large development of the canines *Mixtotherium* is more like the pigs, but showing affinities to the Anoplotheroids in the form of the brain case. The structure of the molars, as already shown, resemble very closely those of the *Anoplotheriidæ* and have gone one step further in their specialization by the development of a well defined protoloph.

Schlosser in his paper, "Stammesgeschichte der Hufthiere" speaking of the origin of the Sullines remarks "die Herkunft diese Stammes ist noch in vollständiges Dunkel gehüllt, nur so viel dürfen wir als sicher annehmen, dass derselbe wohl von der gleichen Grundform ausgegangen ist wie der der Suiden." The Oreodonts are considered by Scott to be related to the Anoplotheroids, and if this be the case it is not strange that the skull of *Mixtotherium* resembles that of *Oreodon*. The genus *Protoreodon* of the Uinta or Upper Eocene, has the five lobed superior molar typical of the Anoplotheroids, and the primitive Suillines.

In conclusion, *Mixtotherium* is then a type intermediate between the Suillines and the Anoplotheroids, and has been derived from a common stock, which also gave origin very probably to the Oreodonts.—CHARLES EARLE, Laboratoire de Palæontologie, Jardin des Plantes, Paris.

The Glaciers of Greenland.—Prof. Chamberlin's report on the Geology of Greenland contains the results of his observations of glacier phenomena in the region explored by the Peary auxillary expedition of 1894. The seventeen glaciers visited fall into two classes designated the southern and northern types. The former are distinguished by ending in a slope of moderate declivity, the latter end in abrupt terminal walls which rise to heights of 50 to 150 feet. The author notes here that he is speaking of glaciers that end upon the land. Obviously, those that reach the sea terminate in vertical walls through the breaking away of the ends. Not only are the ends of the glacial tongues vertical, but in some instances the sides are so likewise. To some extent the edge of the ice-cap itself is vertical.

The stratification of these glaciers is remarkable for extent and definiteness. The ice is almost as distinctly bedded as sedimentary rock. The following points are noted by the author:

"In the vertical face there are usually presented two distinct divisions, an upper one of nearly white ice, whose laminations are not conspicuous, from lack of differential coloration, and a lower one discolored by debris, which gives great distinctness to the bedded structure. The lower divisions is divided by very numerous partings, along which are distributed rocky debris, embracing not only sand and silt, but rubble and boulders. Often the amount of this interspread debris is so sligbt as to constitute the merest film, while at other times it reaches a thickness of an inch or two. . . . . . In general, the rocky debris is arranged in very definite and limited horizons leaving the ice above and below as clean and pure as any other. It is very notable and significant that the ice next the debris layers is the firmest and most perfect that the glacier affords. The coarser debris is arranged in the same horizons with the fine silt and clay. . . . . . Where ice is well laminated, as it commonly is, the laminations bend under and over the embedded boulders. This seems to indicate that the embedded boulders do not descend through the ice by virtue of superior gravity, but are retained in the original position given them by the embedding process. The extent to which the basal portion of the ice is laminated is remarkable. In selected cases twenty laminations might be counted to the

inch. These laminations are sometimes symmetrical, straight and parallel. At other times they are undulatory, and in instances they are greatly curved and contorted in an intricate fashion."

It was observed that the debris bearing layers were parallel to the base of the glacier and were confined to its lower 50 or 75 feet, with some few exceptions. Even at the border of the glacier clean layers of white ice above the debris strata constituted one-third or more of the section. This is contrary to the view that the debris habitually works up to the surface and forms a layer there as it nears the border of the glacier.

Prof. Chamberlain was fortunate in being able to observe the process of introduction of debris in progress. At a point in the Gable glacier there was found an embossment of rock over which the ice was forced to pass and in so doing to rise in a dome-like fashion. One side of the dome was melted away, revealing operations at its base. Combining a number of observations, the author gives the following interpretation of the process:

"The bottom layer of the ice in passing over the crest of the embossment would be pressed with exceptional force upon it, and would, as a result, be especially liable to detach fragments from it and imbed them within itself. If debris were being pushed or dragged along between the ice and the rock surface beneath, it would be pressed into the ice and the ice compacted about it with exceptional force. As any given portion of the basal layer passed beyond the crest of the embossment, the vertical pressure would tend to cause it to follow down the lee slope, while the horizontal thrust of the moving ice would tend to force it straight forward. If any given portion yielded to the first and passed down the slope, it would produce a curve in the hardened basal layer of ice. As a result of this, the horizontal thrust, instead of continuing to act along the disadvantageous curved line, and against the superior friction of the bottom, would be disposed to cause the layer to buckle at the bend. The fold so formed would be elongated and appressed by the continuation of the process and become a layer. The ice, beneath, however, would gradually yield, and the debris layer would settle down out of the line of maximum thrust and the conditions for a new fold be induced."

Cases of true faulting and overthrust were seen, the rocky debris being carried along the fault plane.

As to the method of movement, Prof. Chamberlin presents evidence, which taken in connection with the intrusion and interstratification of earthy material, would seem to indicate that these glaciers move, in some notable part at least, by the sliding of one layer upon another.

Several instances were noted where the glaciers had advanced over their terminal moraines by riding up over them, but none where the ice showed any competency to push the frontal material, even its own debris, before it.

A driftless area was discovered on the east side of Bowdoin Bay immediately adjoining the present great ice-cap. (Bull. Geol. Club, Phila., 1895.)

BOTANY.[1]

New Species of Fungi.—The activity of our fungologists is indicated by the long lists before us which have been published within the last few months. From the Proceedings of the Academy of Natural Sciences of Philadelphia (1895, pp. 413 to 441) we have "New Species of Fungi from Various Localities," by J. B. Ellis and B. M. Everhart, including ninety-nine species. Many of these are from Colorado and other western regions. We note among the more interesting species the following, viz.: *Fomes alboluteus*, from an altitude of 10,000 feet, in Colorado; *Bovista cellulosa, Lycoperdon alpigenum*, both from Colorado, the latter from an altitude of 11,500 feet; *Rosellinia geasteroides* from Louisiana; *Phyllachora plantaginis*, parasitic on *Plantago rugelii*, in Wisconsin.

The same authors publish in the October (1895) *Bulletin of the Torrey Botanical Club*, a paper on "New Species of Fungi" in which there are described eight new species from the Sandwich Islands, eleven from Florida, and six from Mexico. It is with much pleasure that we observe that but two of the specific names are dedicated to persons, viz.: *Schizophyllum egelingianum* (probably a synonym for *S. commune*) and *Melogramma egelingii* from Mexico. It is to be hoped that the good example here set may be followed by others upon whom it falls to find names for new species.

In the Fourth Report of the Botanical Survey of Nebraska, just issued, fifty-five new species of fungi are described by Roscoe Pound, F. E. Clements and C. L. Shear. These are distributed as follows: in the *Mucoraceæ*,1; *Sphærioideæ*, 1; *Mucedinaceæ*, 2; *Dematiaceæ*, 2; *Stilbaceæ*, 1 (in the new genus *Trichurus* of Clements and Shear); *Tuberculariaceæ*, 2; *Helvellaceæ*, 2, *Pezizaceæ*, 24; *Bulgariaceæ*, 1; *Agari-*

[1] Edited by Prof. C. E. Bessey, University of Nebraska, Lincoln, Nebraska.

caceæ, 20. In the last named family the name *Gymnochilus* is substituted for *Psathyra* of Fries (1821) which must fall, since it is identical with Commerson's *Psathura* (Juss. Gen. ,1789). In the *Pezizaceæ* the name *Lachuea* Fries (1822), being identical with *Lachuæa* L. (Sp. Pl., 1753), must give way to *Sepultaria* Cooke (1879).—CHARLES E. BESSEY.

Alaskan Botany.—In the Contributions from the U. S. National Herbarium (Vol. III, No. 6), F. V. Coville makes a report upon the collections of plants made on Yakutat Bay, Alaska, in 1892, by Frederick Funston. Mr. Coville's paper is preceded by a Field Report made by Mr. Funston. The latter contains much interesting information as to the country and its vegetation. In regard to the latter the author says, "The plant life of the region about Yakutat Bay is characterized by the dense and vigorous growth of a comparatively small number of species, giving the forests especially an appearance of great sameness. The almost level country lying on the eastern side of the bay, between Ocean Cape and the foothills of the mountains, is covered with a forest growth practically impenetrable. The great amount of fallen timber, together with the tangled and heavy undergrowth constitute such obstacles to travel that even the Indians who have lived here many years have never penetrated the forests of the mainland for a mile from their own village. The great bulk of this forest is composed of the Sitka Spruce (*Picea sitchensis*), which in this region reaches a height of seventy feet. This tree extends from sea level to an altitude of 2,200 feet on the sides of Mt. Tebenkof; but as one follows the coast line up the bay from this mountain, the upper limit becomes lower and lower, until at the entrance of Disenchantment Bay it reaches sea level, the tree not being found on the shore of this bay. A large forest lies along Dalton Creek, and there are several of considerable extent between this place and Point Manby."

"The timber of the spruce tree plays a most important part in the economy of the natives, as from it are constructed their houses and canoes, and it is used in the manufacture of oil crates, bows, arrows and other implements, while the smaller roots after being boiled and split are used in basket weaving."

The other woody plants mentioned are the hemlock (*Tsuga mertensiana*), Sitka cypress (*Chamæcyparis nootkatensis*), red alder (*Alnus rubra*), a willow (*Salix barclayi*), the elder (*Sambucus racemosa*), the Menziesia (*Menziesia ferruginea*), high bush cranberry (*Viburuum pauciflorum*), the blueberry (*Vaccinium ovalifolium*), salmon berry

(*Rubus spectabilis*), devil's club (*Echinopanax horridum*), and black currant (*Ribes laxiflorum*).

The catalogue of species includes 159 species, of which 122 are Anthophytes; 3, Gymnosperms; 9, Pteridophytes; 25, Bryophytes. The ten largest families are as follows: *Rosaceæ*, 13 species; *Carduaceæ* (*Compositæ*), 10; *Poaceæ* (*Gramineæ*), 10; *Ranunculaceæ*, 9; *Saxifragaceæ*, 9; *Scrophulariaceæ*, 8; *Ericaceæ*, 7; *Polypodiaceæ*, 6; *Ammiaceæ* (*Umbelliferæ*), 6; *Brassicaceæ* (*Cruciferæ*), 5.—CHARLES E. BESSEY.

Aquatic Plants of Iowa.—R. I. Cratty has published in the Bulletin of the Laboratories of Natural Science of the University of Iowa (Vol. III, No. 4) some "Notes on the Aquatic Phenogams of Iowa," which will be useful in recording the past and present distribution of plants which are fast disappearing. It is a pity that author and editor permitted the antiquated spelling of Phanerogam to be used. There can be no valid excuse for "Phenogam." The species noted are *Arisaema triphyllum, A. dracontium, Symplocarpus fœtidus, Acorus calamus, Lemna minor, L. trisulca, L. polyrrhiza, Wolffia braziliensis, Typha latifolia, Sparganium simplex, S. androcladum, S. eurycarpum, Naias flexilis, Zannichilia palustris, Potamogeton natans, P. amplifolius, P. nuttallii, P. lonchitis, P. heterophyllus, P. illinoensis, P. prælongus, P. perfoliatus, P. zosteræfolius, P. foliosus, P. major, P. pusillus, P. spirillus, P. pectinatus, Triglochin maritima, Scheuchzeria palustris, Alisma plantago, Echinodorus rostratus, E. parvulus, Sagittaria arifolia, S. latifolia, S. rigida, S. graminea, S. cristata.*—CHARLES E. BESSEY.

Another Elementary Botany.—Professor MacBride has recently brought out a little book on botany for secondary schools, under the title of "Lessons in Elementary Botany," issued by the house of Allyn and Bacon of Boston. The author presents in small space essentially that phase of botany with which we have long been familiar in Gray's "Lessons," Miss Youmans's "First Book," "Second Book" and "Descriptive Botany," and Wood and Steele's "Fourteen Weeks in Botany." Whatever merits and demerits these works have are here reproduced, somewhat modified of course. The lessons begin with "buds," followed by "stems," "roots," "the leaf," "inflorescence," "the flower," "the fruit and seed." These topics occupy about eighty-five pages, and while the subject matter is essentially similar to that in Gray's "Lessons," the treatment resembles that of Youmans's books, considerably simplified. The pupil is required to work out the

details of structure by actual examination. The remainder of the body of the book (pp. 85 to 207) is taken up with selected plants whose structure is to be worked out, and here the treatment reminds one of Wood and Steele's book and the corresponding chapters in Miss Youmans's earlier books. There is here, however, a considerable improvement in the presentation of the matter, the pupil being led on by questions which direct attention to different details.

A valuable part of the book is found in the appendix, where directions are given for collecting and preserving materials for study. Taken altogether, the book is a good one, although we cannot agree with the author that gross anatomy alone, and that practically confined to the flowering plants, is all that can be done in the secondary schools. We prefer the work suggested by the Natural History Conference, as reported by the Committee of Ten, and know from much personal experience that the high schools are rapidly supplying themselves with compound microscopes, by means of which the pupils are obtaining some knowledge of the lower plants, and of the vegetable kingdom as a whole. Neither can we endorse what the author says in the preface as to the relative value to the pupil of a knowledge of the higher rather than the lower plants. But with all these criticisms it must not be thought that the book is a poor one; on the contrary, for schools where the conditions are such as the author describes and where they must so remain, the book is a very good one.—CHARLES E. BESSEY.

Botany in the United States Department of Agriculture. —From the recent Report of the Secretary of Agriculture, we glean the followings items, relating to the work in botany. Investigations for determining the strength of timbers of various species have been continued in the Division of Forestry, no less than 13,000 tests having been made during the year preceding the report. Measurements upon a large scale of the rate of growth of pine trees have been begun and some preliminary results obtained. Under this head the announcement is made of the establishment of experimental plantings at several points upon the Great Plains. In the Division of Botany the following announcement is gratifying to botanists. "The herbarium of the Department of Agriculture, commonly called the National Herbarium, having out-grown its old quarters, was, by kind permission of the Secretary of the Smithsonian Institution, removed and well installed in the fire-proof building of the National Museum, where it will be cared for by the botanists of this Department. This herbarium is steadily being built up and enlarged at the expense of the Department of Agriculture."

The new division of Agrostology, established during the current fiscal year has for its special work the scientific and economic study of the grasses and others forage plants. In connection with this work it is the purpose of the officers of the Division to establish "Experimental Grass Stations" in which the study of particular species may be more readily pursued.

The division of Vegetable Pathology "has been broadened during the year to include plant physiology," and the Secretary adds, "It is believed that this will add materially to the value of the investigations."

The abolition of the "Division of Microscopy" is announced. When first established, twenty years ago microscopy "was considered a separate branch of technology, but since that time the microscope has come into daily, almost hourly, use in nearly all scientific laboratories." The Secretary very properly concludes that a separate division is now "an absurdity."—CHARLES E. BESSEY.

Notes on Recent Botanical Publications.—From the Division of Botany of the U. S. Department of Agriculture we have John M. Holzinger's "Report on a collection of Plants made by J. H. Sandberg and Assistants in Northern Idaho in the year 1892." Some new species are described, viz., *Cardamine leibergii* (figured in Plate III as *C. sandbergii*), *Peucedanum salmoniflorum*, *Dicranoweisia contermina*, *Orthotrichum holzingerii*, *Bryum sandbergii*, and *Peronospora giliæ*.—Another contribution from the same source is the "Report on Mexican Umbelliferæ, mostly from the State of Oaxaca, recently collected by C. C. Pringle and E. W. Nelson," by John M. Coulter and J. N. Rose. As was to be expected, many new species were found in the collection.—With the preceding paper is a smaller one by J. N. Rose, entitled "Descriptions of plants, mostly new, from Mexico and the United States," the new species from the United States are *Ligusticum eastwoodæ*, from the La Plata Mts., Colorado; *Vlæa glauca*, from Oregon; and *Thurovia triflora*, a curious Texan composite for which a new genus had to be erected.—From the Field Columbian Museum we have C. F. Millspaugh's "Contribution to the Flora of Yucatan," which is marked "Botanical Series, Vol. I, No. 1," of the publications of this new centre of scientific activity. It includes the results of an expedition to Yucatan made in January, 1895, to which the author has added species compiled from Hemsley's *Biologia Centrali-Americana*.—M. E. Jones's "Contributions to Western Botany," published in the Proceedings of the California Academy of

Sciences, is mainly taken up with the new species discovered by him while acting as Field Agent for the U. S. Department of Agriculture. The author says "the long delay in the publication of the report necessitates the early publication of the new species." The author does not follow the "Rochester Rules" of nomenclature, and gives some reasons for not doing so, but the reader is amused to find under *Oxytropis acutirostris* (Watson) the remark "should it be necessary to reduce this genus to *Spiesia*, the name must be *S. acutirostris* (Watson)," and again under *Oxytropis nothoxys* (Gray), the synonym *Spiesia nothoxys* (Gray). For one who does not accept the "Rochester Rules" this is indeed a remarkable proceeding, since it is the deliberate addition of two synonyms (with "Jones" as the authority) to what the author calls "the mass of new names, nine-tenths of which are wholly useless."—K. C. Davis has issued a "Key to the Woody Plants of Mower County, in Southern Minnesota, in their Winter Condition" in the form of a five-page pamphlet. It will be useful in the region for which it is intended.—An interesting paper comes from Dr. G. Clautriau of Brussels, entitled Étude Chemique du Glycogène chez les Champignous et les Levures," from which we hope to make extracts in some future number.—CHARLES E. BESSEY.

VEGETABLE PHYSIOLOGY.[1]

Ambrosia.—By this name Schmittberger designated a soft watery substance found in the burrows of certain beetles and supposed to be of use in feeding the larvæ. The exact nature of this ambrosia appears to have been for a time in doubt, owing to the fact that it was generally seen by entomologists rather than by mycologists. Of late years, however, it has been conceded to be of fungous origin, although no one appears to have studied it critically. Since the appearance of Möller's book on the Fungous Gardens of South American Ants, the subject of ambrosia has received renewed attention. In this country, Mr. Henry G. Hubbard, who has long paid especial attention to the habits of coleoptera, has repeatedly observed this substance in the chambers of *Xyleborus pubescens* in orange trees in Florida, and has recently discovered it in the burrows of *Corthylus punctatissimus* in

[1] This department is edited by Erwin F. Smith, Department of Agriculture, Washington, D. C.

the roots of whortleberry near Washington, D. C. Specimens from the latter source were submitted to various students of fungi in Washington last autumn for identification, and the writer had full opportunity to examine this substance. Some of the chambers were filled with it, others partly filled, and others free from it. It is a colorless much septate mycelium, inclined to be constricted at the septa, and in places consisting of rounded, nearly iso-diametric, colorless, rather thick-walled cells, not sufficiently differentiated from the mycelium to be considered as true spores. It appears to be the mycelial or oidial stage of some higher fungus, probably of some Ascomycete. From its distribution in the burrows and the behavior of the beetles toward it, there can be little doubt that it serves them for food. Whether like the ants they actually cultivate it, is another question and one more difficult to solve. In Germany, where this ambrosia was first discovered, Prof. R. Goethe, Director of the Royal Lehranstalt fur Obst-Wein-und Gartenbau zu Geisenheim am Rhein, has recently published an account of its discovery in the chambers of *Xyleborus dispar*. Prof. Goethe's brief note (p. 25, *Berichte d. Kgl. Lehranstalt* etc.) is accompanied by a good figure, judging from which the fungus appears to be the same as that found in the chambers of *Corthyllus punctatissimus* near Washington. This fungus is said to be the same as that found in 1883 in the burrows of *Xyleborus* in cherry trees at Kamp am Rhein. Concerning the use made of this fungus by the beetles he makes the following statement: Seine Wucherungen dienen ganz unzweiflehaft den Käfern zur Nahrung, denn man sieht deutlich, wie der Ueberzug stückweise abgeweidet wird. Further study of this subject would undoubtedly bring to light many interesting things. In the next number of the NATURALIST I hope to publish a note from Mr. Hubbard on this subject.—ERWIN F. SMITH.

White Ants as Cultivators of Fungi.—In connection with the preceding it may be worth while to reprint part of a note which appeared in *Grevillea*, June, 1874, p. 165–6, relative to the occurrence of fungi in the nests of termites in India. A writer in the *Gardeners' Chronicle* stated that he had never seen any fungi on or in nests of white ants except very small ones less than the size of a pin head. In opposition to this Mr. W. F. Gibbon, Doolha, Goruckpore, wrote to the Horticultural Society of India as follows: "I send you now a bottle containing mushrooms I extracted a few days ago from the center of a white ant hillock. When I collected them they were in appearance like asparagus, over 14 inches in length, and the people about here

consider them particularly good eating, partaking of them both raw and cooked. When I read the above article in your Society's Journal somewhat over a year ago, I was then aware that mushrooms existed in the interior of ant hills, for I had often seen them, but I did not know their season of sprouting, and whenever I searched was unsuccessful till the other day. I have now ascertained the season they sprout is the end of August or the beginning of September, and I believe all ant hills produce them. These mushrooms appear to me to proceed from a peculiar substance always found in ant hills in this country (whether white or black), generally called ants' food, a bluish gritty substance, like coarse wheat flour turned mouldy and adhesive. In dry weather brittle, and in damp weather like soft leather. It is this substance, under the combined influence of heat, damp and darkness from which the mushrooms grow. As my experience is at variance with the writer in the *Gardeners' Chronicle*, you may care to record it. * * * I would like these mushrooms, if possible, referred to some mycologist, and their names ascertained; and I would like also to know if the bluish substance, the ants' food, was collected and treated artificially, could similar mushrooms be raised." These mushrooms were submitted to Dr. D. D. Cunningham, who reported as follows: "I herewith return the letter sent to me more than a month ago, along with specimens of fungi said to have been procured from the interior of a white ant hill. The specimens apparently belong to some species of *Lepiota*, and are chiefly remarkable for the extreme length and coarse fibrous contents of the stem. The occurrence of fungi in connection with ant hills is well known, but in so far as I am aware, those hitherto described as occurring on the hills of the white ant belong to species of the Gasteromycetous order *Podaxinei*, so that the occurrence of a species of one of the sub-genera of Agaricus in such localities is a new and interesting fact. With regard to the material from which they arise, and which must apparently be of the same nature as the so-called spawn of the cultivated mushroom, consisting of vegetable debris permeated by the mycelium of the fungus, it may be noted that a similar substance is described by Belt as occurring in the nests of the leaf-cutting ants in Nicaragua, and is supposed by him to serve as food—the ants culling and storing the leaves for the sake of the fungi which are subsequently developed in the debris (*Naturalist in Nicaragua*, p. 80). Were this spawn artifically exposed to conditions similar to those which it naturally encounters in the interior of the hillocks—heat, darkness and moisture—I believe that the pilei

might very probably be raised at will, and if they really are good eating, the experiment would be well worth trying."

—ERWIN F. SMITH.

Desert Vegetation.—Perhaps the most interesting part of Rev. George Henslow's recent book, *The Origin of Plant Structures*, are the two chapters on desert plants. The first of these chapters is devoted to a consideration of the origin of the morphological peculiarities of desert plants; the second to the histological peculiarities of such plants. A large amount of data are brought together, rather hastily it would appear, going to show that the peculiarities of desert plants are the direct outcome of the conditions under which they grow, in other words, that these peculiar modifications, such as reduction of leaf surface, increase of succulency, acquisition of spines, development of water storage tissues, sinking of the stomata below the level of the surface, excessive development of cuticle, of wax, or of hairiness, change from annual to biennial or perennial, increased length of roots, etc., are all brought about by the direct action of environment on the plant. "Natural selection," in the author's own words, "plays no part in the origin of species." These two chapters are well worth the perusal of all who are interested in the study of the flora of our western mountains and arid plains, and the whole book will serve to provoke thought. Other chapters deal with origin of structural peculiarities of alpine and arctic plants; maritime and saline plants; phanerogamous aquatic plants, etc. The book is a companion volume to the author's *Origin of Floral Structures through Insects and other Agencies*.—ERWIN F. SMITH.

A Second Rafinesque.—*Die Pestkrankheiten (Infectionskrankheiten) der Kulturgewächse; Nach streng bakteriologischer Methode untersucht und in völliger Uebereinstimmung mit Robert Kochs Entdeckungen geschildert von Prof. Dr. Ernst Hallier*, is one of the querest books it was ever the lot of the writer to read. It was published at Stuttgart in 1895 by Erwin Nägale, and contains 144 8 vo. pages and 7 fairly well executed plates. Concerning this book it may be said that its author is either an undiscovered great genius or else a very crazy man. About one-third of the book is given up to caustic abuse of Anton de Bary and his students, relative to which it may be said that Dr. de Bary's reputation is safe not only in the hands of his friends but also in the hands of all who love clear thinking and honest work; and all this without defending any of the errors into which he may have fallen. Another third of the book or thereabouts is devoted to the description of old and well known species of Peronosporaceæ,

little that is really new being added, but most facts being correctly stated. The names of many of the species, however, are changed for reasons which would not be recognized as good even by the most ultra radical. For example *Cystopus candidus* is changed to *C. capsellæ* E. H. because the fungus is said to grow mostly on Capsella and every fungus should be named as far as possible from the host it infests. In like manner *Cystopus cubicus* becomes *C. compositarum* E. H.; *Phytophthora infestans, P. solani* E. H.; *Peronospora sparsa, P. rosæ* E. H., etc. In the same way the author puts his initials after many old genera e. g., Phytophthora and Peronospora, or substitutes other names, e. g. *Zoospora* E. H. for *Plasmopara*, because he concieves the name to have been originally employed in a different sense from that in which it is now used or in which he employs it. The other idea running through the book and occupying at least a third of it is that bacteria originate from plastids developed inside of the cells of fungi, and that we shall never make any progress in the study of animal and plant diseases due to bacteria until we determine from just what fungi they originate. The potato rot, for example, is due to bacteria developed from the broken down mycelium of the fungus *Phytophthora infestans.*

"If now one keeps for a long time in observation under the microscope such an escaped mass of plasma [from the mycelium or conidia of Phytophthora] one beholds, just as in the cases already mentioned by us, the freeing of the plastids, their change into micrococcus, and the elongation, division, etc. of these." (P. 82). In *Peronospora ficariæ* also "the origin of the microörganisms is unquestionable, but until now I have not been able to follow them further. These organisms are visible in a fresh section in the interior of the leaf tissue of the host." (P. 134.) The converse of this proposition is also true i. e. that under certain conditions bacteria change back again into the original fungus, the growth of certain yeast cells into mycelium being cited as a case in in point. "If these [bacteria] arise from definite fungi by the finally free development of the plastids, it must also come to pass that the micrococcus, which is the first product of the freed plastids, will again give rise to the higher fungous form from which it originated. Of this the first well known and precise example is the history of the development of the beer yeast." (P. 105.). The author who is a graduate of one of the German Universities, formerly held a chair of botany in one of them, and has been writing books similar to this one for the last 30 years claims to have seen the change from fungous plastids inside of mycelia or spores into genuine free swimming bacteria, rods and cocci. This change is difficult to bring about artifically, requiring long watch-

ing at the microscope and the partial exclusion of air from the preparation. Figures are given of these plastids and of the bacteria. All of which reminds us of the proof of miraculous healing by holy water at certain wells, viz., " the well is with us to this day." The author complains that nobody reads his books, but this cannot be charged against the writer who has patiently waded through the whole of this one, to very little profit, however, it must be confessed. The absurdities, however, are not so numerous as in the author's *Phytopathology*, published in 1868. Therein may be found, full fledged or in embryo, most of the queer notions here set forth and also many others.

ERWIN F. SMITH.

ZOOLOGY.

The Cruise of the Princess Alice.—The zoological material obtained by the Prince of Monaco during the past summer cruise of his yacht, the Princess Alice, is abundant and valuable. The fortunate capture of a sperm whale in the vicinity of the yacht, off the coast of Terceira Island, resulted in the acquisition of some rare specimens of the animal kingdom which otherwise might never have been known. From the Prince's narrative of the voyage we learn that the cachalot was the " catch " of some Portugese whalers with whom the Prince arranged to secure what portions of the animal he wished, especially the brain. Unfortunately some days elapsed before the skull was penetrated, and then the brain was found to be in too advanced a stage of decomposition to be of use for preservation. Meantime a large number a parasites were collected from the stomach, the digestive organs, the blubber and the skin of the animal, and the contents of the stomach secured for examination. While in the act of death the whale ejected several large cephalopods which it had only just swallowed, as was evident from their perfect preservation. These were also obtained by the Prince for his collection. Amongst them were three large specimens, each over one meter in length, of a species probably new, of the little-known genus Histioteuthis; also the bodies of two other immense cephalopods so different from all hitherto known that it is impossible to place them in any genus or even family of this order. M. Jonbain proposes for them the name *Lepidoteuthis grimaldii.* One of these specimens is a female, of which the body, or visceral sac after prolonged immersion in formol and alcohol, still measures 90 cm. in length, from which it is

estimated that the length of the complete animal would exceed 2 meters. The surface of the sac is covered with large, solid rhomboidal scales, like those of a pine cone. The fin is very powerful, forms one-half of the length of the body and is not furnished with scales.

When the stomach of the whale was opened it was found to contain over a hundred kilogrammes of partially digested debris of cephalopods, all of them of enormous size. The crown and tentacles of a Cucioteuthis were identified. This genus has hitherto been known only by few fragments. The muscular arms, though shrunken and contracted by the preserving fluid, are as thick as those of a man, were covered with great suckers, each armed with a sharp claw, as powerful as those of the larger carnivora. More than one hundred of these suckers remain adhering to the arms.

Another cephalopod found in the stomach of the whale is provided with a large fin, in the skin of which are enclosed certain photogenic organs. The form of the body suggests a new species, but as the head is wanting, it cannot be positively identified.

These cephalopods are all powerful swimmers, and very muscular. They appear to belong to the fauna of the deep intermediate waters, an almost unknown region. They never come to the surface, no do they lie on the bottom of the sea. Their great agility prevents their capture in nets, hence it would seem that the only way to obtain these interesting gigantic creatures is to kill the giant who feeds upom them and rescue the fragments from his huge maw.

Accordingly, for the next season's cruise, the Princess Alice is to have, in addition to her present fittings, those of a sperm whaler, or else to have as a compainion a special whaling tender.

The further working up of the material in hand is being pushed forward with energy, and interesting results are anticipated. (Nature, Jan., 1896.)

Australian Spiders.—Among the new Arachnida reported from New South Wales are three species of Nephila; *N. fletcherii, N. edwardsii* and *ventricosa.* These are described and figured by Mr. W. J. Rainbow in the Proceeds. of the Linn. Soc. N. South Wales. The author includes in his paper some interesting observations on the habits of Nephilæ and their supposed bird-snaring propensities. Representatives of this genus abound in tropical and subtropical regions. Their webs are composed of two kinds of silk; one yellow, exceedingly viscid and elastic, the other white, dry and somewhat brittle. The latter is used for the framework of the web, the guys and radii, and the former

for the concentric rings. These snares are at varying heights, sometimes within reach, again 10 to 12 feet from the ground, but always in a position exposed to the rays of the sun. The diameter is also variable, from 3 feet upwards. One seen by Gräffe in the Fiji Islands (probably a Nephila) constructs a web 30 feet in diameter.

These snares are strong enough to entrap small birds. In the author's opinion the web is not set for such game, and the spider does not feed on her ornithological victim. In the cases where she has been observed with her fangs in the body of the ensnared bird it is probable that it is for the purpose of hastening the death of the bird in order to prevent its injuring the web in its struggles to escape.

Spiders of the genus Nephila are easily tamed. Although exceedingly voracious, they can nevertheless exist for many days without either food or water. They pair in autumn. The sexes inhabit the same web for a considerable time, the female in the center and the male on the upper edge of the web. His efforts to ingratiate himself in the favor of his mate are not always successful. It not infrequently happens that he has to retire from her presence minus two or three legs. "Ultimately says the author, he succeeds in attaching himself in the requisite position, and performing the necessary act of fecundation." (Proceeds. Linn. Soc. N. South Wales, [2] Vol. X, Pt. 2, 1895.)

Autodax iëcanus.—According to Mr. Van Denburg, *Autodax iëcanus*, a black Salmander first found in Shasta Co., California, is a nocturnal forager. It usually walks slowly along, moving one foot at a time, but is capable of rapid motion when necessary. At such a time it aids the action of the legs by a sinuous motion of the whole body and tail. In addition to being prehensile, the tail is put to a third use. When caught the animal will often remain motionless, but if touched will raise the tail and strike it forcibly against the surface upon which it rests, and accompanying this action with a quick motion of the hind legs, will jump from four to six inches, rising as high as two or three inches. Mr. Van Denburg finds that the species has a wide distribution in California. (Proceeds. Calif. Acad. Sci., Vol. V, 1895.)

Reptiles and Batrachians of Mesilla Valley, New Mexico.—The following list may be worth publishing as a contribution to the more exact knowledge of the distribution of animals in New Mexico. It may be relied upon as correct, as all the species have been identified by Dr. L. Stejneger, and the specimens are to be found in the U. S. National Museum. The valley about Las Cruces, where most of the species were obtained, is 3800 ft. above sea-level, its extreme sides rise

to about 5000 ft. The records marked Lane Coll. are based on specimens obtained by Mr. Lane of Las Cruces, mainly by purchase from the Mexicans.

(1.)* *Bufo lentiginosus* v. *woodhousei.* Common about the town.

(2.) *Rana pipiens* v. *brachycephala.* Common in suitable places.

(3.) *Amblystoma tigrinum.* Not rare about the town. A large specimen found by Mr. J. Schmidt.

(4.) *Cistudo ornatus.* Common about the town.

(5.) *Sistrurus edwardsii.* Close to the College building.

(6.) *Heterodon nasicus.* Close to the College, rather common.

(7.) *Coluber emoryi.* One near Las Cruces, April, 1894 (J. M. Walker).

(8.) *Pituophis sayi.* Our commonest snake. One specimen had the head-scales arranged as in the so-called genus *Churchillia.*

(9.) *Bascanion testaceum.* One specimen.

(10.) *Thamnophis dorsalis.* Frequent, the commonest snake after *Pituophis.*

(11.) *Lampropeltis pyrrhomelas.* H. B. Lane Coll.

(12.) *Lampropeltis splendida.* Lane Coll.

(13.) *Diadophis regalis.* Lane Coll.

(14.) *Arizona elegans.* Lane Coll.

(15.) *Rhinocheilus lecontei.* Lane Coll.

(16.) *Liopeltis vernalis.* Lane Coll.

(17.) *Tantilla nigriceps.* Lane Coll.

(18.) *Leptotyphlops dulcis.* Lane Coll., also one obtained by Prof. C. H. T. Townsend.

(19.) *Eumeces obsoletus.* Not rare near the College.

(20.) *Cnemidophorus tessellatus.* Common about the mesquites bushes.

(21.) *Cnemidophorus perplexus.* Lane Coll.

(22.)* *Sceloporus magister.* One in Coll. Exp. Sta., one in Lane Coll.

(23.)* *Uta stansburiana.* Our commonest lizard, abundant on the college campus.

(24.)* *Crotaphytus wislizenii.* One. Remains of beetles in stomach.

(25.)* *Crotaphytus baileyi.* Apparently not uncommon. One had two young *Phrynosoma modestum* in its stomach.

(26.) *Phrynosoma cornutum.* Common. At Lamy and Santa Fé it is replaced by *P. hernandezii,* which in the neighborhood by Santa Fé ascends to 7475 ft.

(27.) *Phrynosoma modestum.* Common. There also occurs a bluish mutation.

The Death Valley Expedition, much further west, obtained 56 reptiles and batrachians, of which only five (those marked with an asterisk) are common to our list. It is especially noteworthy that there is not a single snake in common.

—T. D. A. COCKERELL, N. M. Agr. Exp. Sta.

Professor Cope's criticisms of my drawings of the squamosal region of Conolophus subcristatus Gray; (Amer. Natural., Febr., 1896, p. 148–149) and a few remarks about his drawings of the same object from Steindachner.—In the February Number of this Journal Prof. Cope makes the following remarks: "Dr. Baur again denies that the exoccipital [paroccipital] articulates with the quadrate in certain genera of the Iguanidæ and gives some figures of that region in the *Conolophus subcristatus,* to sustain his allegation. Unfortunately, though he seems to have taken the elements apart, as I suggested that he do, he did not put them together in their original relation when he had them drawn. I now give two drawings traced from the skull of the same species given by Dr. Steindachner. As these plates represent exactly the characters, which I have observed and described in allied genera, I regard them as correct. It will be observed that there is a considerable contact between the exoccipital and the quadrate. There is also contact with the supratemporal [prosqamosal] and probably with the paroccipital [squamosal]. *The articulation of the quadrate with the exoccipital is universal in the Iguanidæ.*"

To this I have to reply the following: 1. The single elements of the skull of Conolophus were not taken apart at all. The quadrate, prosquamosal, and squamosal of the right side were separated from the rest of the skull, in such a way, that they remained together in natural position. The corresponding left side of the skull remained intact. All this was done two years ago, without the advice of Prof. Cope. My figures were drawn with the camera-lucida and are absolutely correct in every respect. I have two other skulls of Conolophus; several of Amblyrhynchus, Iguana and Cyclura. In all I find the same condition. I have not to change a single word in my original description nor a line in my drawings. The quadrate is not supported by the par occipital [exoccipital Cope] in the Lizards, as Cope stated, but by the squamosal [paroccipital Cope], the prosquamosal [supratemporal Cope] taking also part, if present. The paroccipital does not even touch the quadrate.

2. I know the drawings of Steindachner very well. These drawings, however, have not been made, to show the detailed relations of the different elements of the skull. Especially the regions copied by Cope are drawn quite insufficiently. The sutures between the different elements cannot be made out.

Prof. Cope's drawings are not exact tracings from Steindachner for he has drawn sutures, which do not exist at all in Steindachner's figures. There is no such suture, as he figures between the postorbital (Pob.) and his supratemporal (St.), in the actual specimen, nor in Steindachner's drawing. The real suture between these two elements, crosses Cope's alleged suture at right angles, as can be seen in any of the skulls of the Ignanidæ. In Prof. Cope's figure the outer and upper portion of the distal end of the paroccipital process separates the parietal process from the prosquamosal (supratemporal, Cope). This is not the case; the parietal process is always united with the prosquamosal above the distal end of the paroccipital. The squamosal (paroccipital, Cope) is also drawn quite incorrect; besides its true relations can not be made out at all from Steindachner's figures, which are quite useless in this respect.

Prof. Cope really believes now, that the element in the Testudines called by Cuvier "*occipital extérieure*"; by Owen "*paroccipital*," by Huxley "*opisthotic*" consists of *two* elements, and this he simply does, in order to hold his absolutely unfounded idea of the homology of the squamosal of the Squamata with the paroccipital of the Testudines. The paroccipital is a single element which, in all Reptilia known, lodges in front the posterior semicircular canals. It is free from the exoccipital in the Ichthyosauria, Testudines, and young Rhynchocephalia, it is united with the exoccipital in the whole Archosaurian branch of Reptiles containing the Crocodilia, Phytosauria, Aetosauria, Megalosauria, Iguanodontia, Cetiosauria, Pterosauria; it is also united with the exoccipital in the Plesiosauria and Squamata. It is a fact, that the exoccipital plus paroccipital of the Ichthyosauria, Testudines, and the young Sphenodon are homologue to the exoccipital plus united paroccipital in the Squamata and other Reptilia. In the first case the paroccipital is free from the exoccipital either during the whole life, or during the younger stages, in the second case it becomes very early united with the exoccipital. The paroccipital portion of the exoccipital of the adult Sphenodon is homologous to the paroccipital portion of the exoccipital in the Squamata, and to the free paroccipital in the Testudines. If the paroccipital of the Testudines contains 2 elements, as Prof. Cope sees it, then the paroccipital portion of the Squamata

must also contain 2 elements. How then it is possible that the squamosal of the Squamata, can be one of the two elements? The paroccipital has always been a single element from the oldest Fishes and Batrachia up to the Reptilia.

The squamosal of the Squamata (Ophidia, Lacertilia, including Mosasauridæ) is homologous to the squamosal of *Saphæosaurus* (Sauranodon) of the Rhynchocephalia, and of the Ichthyosauria. In all these groups the squamosal is free from the prosquamosal. I have shown that the so-called squamosal of Sphenodon is the homologue of the squamosal plus prosquamosal of the Jurassic Saphæosaurus and the squamosal plus prosquamosal of the Lacertilia. In all other Reptilia, in Birds and Mammals the squamosal is a composit, which is homologous to the squamosal plus prosquamosal of the Stegocephalia, Ichthyosauria, Lacertilia, and Saphæosaurus of the Rhynchocephalia. (Baur G. Bemerkungen über die Osteologie der Schläfengegend der höheren Wirbelthiere. Anat., Anz. X, 1894, pp. 314–330).

I wish Prof. Cope would find the ancestors of the *Testudines*, it would be very important; but for the establishment of the homology of the paroccipital we do not need them; even then the paroccipital will be found to be a single element and not two.

—G. Baur, University of Chicago.

The Food of Some Colorado Birds.—Looking over some old memoranda, I came across the following records of the stomach-contents of birds, which may possibly be worth preserving.

(1.) *Cyanocitta stelleri macrolopha.* Shot Aug. 27, 1889. Willow Creek, Custer Co., Colo. Food, wheat grains and fragments of an insect, not complete enough for identification.

(2.) *Zenaidura macroura.* Shot Aug. 28, 1889. Willow Creek, Custer Co., Colo. Food, a single rather large seed.

(3.) *Canaca obscura.* Willow Creek, Custer Co., Colo. Food: crop containing many berries of *Arctostaphylos uva-ursi*, and some leaves of a different plant; stomach containing seeds; intestine with remains of insects.

(4.) *Falco sparverius.* Shot by Rev. A. Wright, Willow Creek, Custer Co., Colo. Food, stomach full of grasshoppers, apparently *Camnula pellucida* var. *obiona.* The mass was colored red.

(5.) *Falco sparverius.* Shot by Mr. W. P. Lowe at the head of the Big Arroyo, Colo. Food, remains of grasshoppers, and a species of *Anabrus*, identified for me by Prof. L. Bruner as *A. purpurascens.*

(6.) *Tyrannus verticalis* ♂. Shot by Mr. W. P. Lowe, Big Arroyo,

Colo., May 11, 1890. Food, *Euphoria inda*, one specimen, almost whole; *Cicindela* sp., fragments; hymenopterous insects, broken, rather large, thorax black, abdomen red.

(7.) *Pyranga ludoviciana.* ♂. Shot by Mr. P. Lowe, Big Arroyo, Colo., May 14, 1890. Food, fragments of a blow-fly (*Lucilia* or *Calliphora*); fragments of a beetle (perhaps a longicorn); and some green eggs, apparently those of a *Smerinthus.* These eggs were numerous, but I found no fragments of the ♀ moth in which they must have been when eaten.

(8.) *Salpinctus obsoletus.* Shot by Mr. W. P. Lowe, Big Arroyo, Colo., May 14, 1890. Food, fragments of bettles, including a weevil.

(9.) *Geococcyx californianus*, ♂. Shot by Mr. W. P. Lowe, Big Arroyo, Pueblo Co., Colo., Dec. 5, 1889. Food, grasshoppers (*Acrididæ*), *Ophryastes tuberosus* and perhaps another allied species, and a blue-green rugose metallic fragment of an unknown insect.

(10.) *Ampelis garrulus*, ♀. Shot by Mr. W. P. Lowe, Badito, Huerfans Co., Colo. Food, berries of juniper (*Juniperus communis*).

(11.) *Aphelocoma woodhousei*, ♂. Shot by Mr. W. P. Lowe, Badito, Huerfans Co., Colo. Food, fragmentary seeds (papilionaceous?), fragments of bones of a small passerine bird.

(12.) *Merula migratoria.* Cusack Ranch, Custer Co., Colo., April, 1888. Food, seeds and geodephagous beetles.

Mr. Lowe is responsible for the identification of the birds shot by him; he sent me only the stomach-contents.

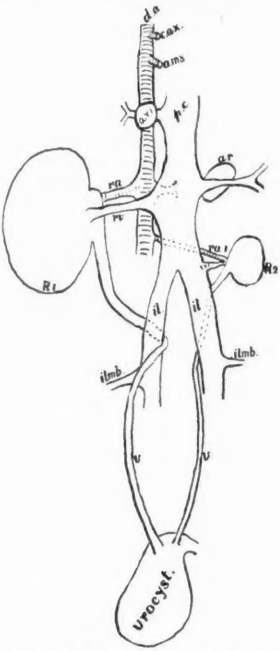
—T. D. A. Cockerell, N. M. Agr. Exp. Sta.

The Manx Cat.—A correspondant of the Zoologist notes an interesting fact concerning a Manx cat in his possession. This tailless cat took of its own accord a mate of the normal type, and from the union resulted a litter of three, which like the mother lacked tails. Friendly relations continued to exist between the parent cats until six successive litters had been produced, each litter in turn showing to a less degree the mother Manx cat's influence upon the form of the progeny, as may be seen in the following table compiled by the owner of the cats.

Litters.	Tailless.	Half tail.	Normal tail.
1	3	0	0
2	2	1	0
3	1	2	0
4	0	2	1
5	0	1	2
6	0	0	3

It would be interesting to carry the experiment further and see if a union of the Manx cat with one of her own race would result in restoring with the same regularity with which she lost it, the power to produce her own type. (Revue Scientif. T. 4, 1895.)

A case of Renal Abnormality in the Cat.—Anomalous condition of the renal organs and accompanying blood vessels was recently disclosed in a dissection in this laboratory. The accompanying diagram explains the phenomenon. The left kidney was a miniature of the right though functional. The dimensions of the right kidney in another subject of equal size as the specimen under discussion were found to be—length 3 cm., width 2 cm. and dorso-ventral thickness 15 mm.; the left os is natural being slightly smaller than this. The dimensions just given may be regarded as normal.



In the subject whose renal anatomy has been here figured, the measurements of the right kidney were as follows: length 4 cm. breadth 2½ cm. and thickness (dorso-ventral) 19 mm., considerably above the normal as one would expect when the extremely small size of the left kidney is considered. The dimensions of the latter were as follows: length 12 mm., breadth 8 mm., and thickness or dorsoventral diameter 5 mm., less than one-third the dimensions of the right kidney.

Upon hardening, staining and sectioning in the usual way the glomeruli and uriniferous tubules were found to be normal though, the presence of a small amount of fat in the kidney was noted. The histological condition of the kidney and the presence of the left ureter, which, though smaller than the right was clearly functional, proved that the left kidney was of value in the vegetative processes of the organism. The right renal artery (*ra*) was, as one would expect larger than the left (*ra*). The postcava (*pc*) in this cat was divided very far forward in the lumbar region to form the common iliac veins, causing the left

renal vein (*rvi*) to empty into the left common iliac. This variation from the normal in postcaval structure is by no means uncommon.

Letters in the figure, not referred to in the text are as follows: *da.* dorsal aorta, *cax.* cœliar axis, *a. m. s.* anterior mesenteric artery, *rv.* vein from right kidney, R_1. right kidney, R_2. left kidney, *ar.* and *ari.* left and right adrenal bodies with accompanying veins. *Il* left and right common iliacs, *ilmb.* ilio-lumbar veins *u* ureters, *urocyst* urinary bladder.—F. L. WASHBURN, Biological Laboratory, University of Oregon.

Zoological News.—Mr. O. F. Cook has published a monograph of Scytonotus. He considers this genus to be the most specialized of the Polydesmid Myriapoda, basing his conclusion on its secondary sexual characters. He recognizes nine species as belonging to the genus. (Ann. New York, Acad. Sci., VIII).

A gigantic Cephalopod, supposed to be a new species of Architeuthis, was driven inshore on the eastern side of the bay of Tokyo. A description of it, illustrated with drawings, is published by K. Mitsukuri and S. Ikeda. It is characterized by shape of its fins and of its beaks, the unequal lengths of the sessile arms, and other minor details. (Zool. Mag., Vol. VII, 1895).

Prof. Gegenbaur has in the Morphologisches Jahrbuch for the year 1895, instituted a study of the clavicle and the elements adjacent to it and the scapular arch. He calls attention to the fact that there are two elements in the position of the former in Dipnoi, Crosopterygia and Chondrostei. He then shows that the element nearest the scapula is retained in some of the Stegocephalia, while the anterior and distal element is increased in length. He calls the former the cleithrum, and retains for the latter the name clavicle. The clavicle only remains in the existing order of Batrachia, and higher groups, while the cleithrum only remains in the higher fishes, beginning with Lepidosteus and Amia.

According to Dr. Delisle the cranial capacity of the Orang-Outang averages 408 cubic centimeters. (L'Anthropologie Tome, VI, 1895.)

Ranke's researches show that the weight of the human brain is much greater in proportion to the weight of the spinal cord than in any other vertebrate. (Correspondenzblatte).

Dr. E. Rosenberg publishes in the Morphologisches Jahrbuch for 1895, an investigation into the reduction of the number of the incisor teeth which is seen in the human species. He shows: first, that the loss of

the external incisor, which was first pointed out by Cope, and which has been observed independently by several others, is frequently observed in Europe as well as in America; second, that the loss of the first inferior incisor is also not very uncommon in Europe and that the final reduction of the inferior incisors, should it take place, will be by the loss of this tooth and not by that of the external incisor as in the superior series. He, therefore, believes that the ultimate formula of the incisive dentition in man will be $I\frac{1}{1}$, and not $I\frac{1}{2}$, as Cope left it.

ENTOMOLOGY.[1]

The Segmental Sclerites of Spirobolus.—The structure of the segments of Diplopoda has long been a morphological puzzle. On account of the possession of two pairs of legs they have in a general way been supposed to be double segments, that is, formed by the coalescence of two distinct embryonic or theoretical segments. Toward a morphological demonstration of this idea there has been little progress. Indeed, there are many facts which give grounds of suspicion as to its correctness. Among these may be noticed that the double footed state does not occur in the embryo at all, and that the segments which in the adult bear two pairs of legs either do not exist in the newly hatched larva or do not bear any legs at that stage, the newly hatched diplopod larva having but three pairs of legs, the posterior of which is attached to the fourth segment (at least in the Polydesmoidea). Moreover, all Diplopoda have apodous segments not differing otherwise from those which bear legs; also all Diplopoda have segments which bear but one pair of legs, and yet have not been found to be greatly different from the others. Growing Diplopoda acquire segments by intercalation in front of the last. The segment is added at one moult, the legs for it at the next. As the possession of two pairs of legs has been the occasion of the theories of duplex segments, these facts are the more relevant as objections, since more difficulties are introduced than are disposed of by the theories.

The existence of pluræ in the Oniscomorpha has long been known, and for a less period in the Colobognatha and Limacomorpha. In the other orders these elements of the segmental ring are so thoroughly coalesced or eliminated that their existence was theoretical until their

[1] Edited by Clarence M. Weed, New Hampshire College, Durham, N. H.

discovory in Stemmatoiulus. In that form, however, the multiplicity of peculiar characters weakens the application of homologies to the other orders, unless these can be based on structural facts. It is thus a matter of interest that the existence of pleuræ in another Diplopod order can be affirmed.

Some weeks since in examining large African Spirobolidæ I noticed what seemed to be traces of pleural sutures. On mentioning this fact to Mr. F. C. Straub who was studying with me, he called my attention to a specimen of *Spirobolus marginatus* Say which proved to be very remarkable. Possibly it was collected just after moulting, before the sclerites had become coalesced, or it may have been merely an individual anomaly. At any rate, it had on each side an obliquely longitudinal white line across each segment above the pedigerous lamina, indicating a pleural element about as broad as the lamina. That this is the pleural suture seems very probable, on theoretical grounds and more so that on the surface a special striæ followed the line of white.

What is more remarkable, this line was met above by two others which were transverse, dividing the segment into three subequal parts. These two lines extended completely over the animal, the space between them being somewhat greater above. There is also a median longitudinal suture, and a lateral just below the pore, thus dividing the dorsal portion of the ring into twelve subequal parts. The posterior of the transverse sutures follows the depression found in the segments of Spiroboli and usually called "the suture" in descriptions. The anterior line and the median line are indicated by minute differences in the sculpture, which would not have been noticed had not the white line drawn attention to them. It should be added that the lighter color was not due to anything inside or outside the segmental wall, but was in the wall itself and clearly indicated some structural difference. The phenomenon was exhibited by the anterior and middle segments of the body, becoming indistinct caudad. In all cases the pattern was the same; the whole series of lines could be made out on many segments, and there were no other similar lines or discolorations. The lines were not straight if examined under a microscope, even the median showing minute irregularities. Median sutures are known in four or five of the Diplopod orders and hence may reasonably be expected in all.

Had only the median line been marked as related, there would have been no hesitation in supposing that a median suture was indicated. Theoretical considerations only stand in the way of the reasonable presumption that the other exactly similar lines indicate sutures. If such an interpretation is allowed we are brought to the position that

the segmental ring of Spirobolus consists of sixteen sclerites; twelve dorsal, two pleural and two ventral or pedigerous laminæ. It will be seen that only the last tend to indicate a transverse division of the segment, and in no Diplopod as yet has there been shown a transverse suture carried around the segment and dividing it into two parts. Only the legs and the parts necessarily connected with them, such as the pedigerous laminæ and nerve ganglia are duplicated. Even in the Oniscomorpha, Limacomorpha and Colobognatha where the pleuræ are most distinct, there is not the slightest indication that they were ever divided, and as they are the elements to which the pedigerous laminæ are next related, their evidence is more important than any drawn from the dorsal parts of the segment.

There is another way, however, in which a diplopodous animal might be developed from a monopodous ancestor. Alternate segments may have been suppressed, while the corresponding legs have been preserved. For such a supposition we have the analogy of the Chilopoda, where the pedigerous segments alternate with more or less rudimentary segments. In this case, however, the legs have been lost, that is, we must suppose so if we claim the analogy. Such a theory, while no more fantastic than the other, is probably no nearer the truth. After theoretical explanations have been exhausted we may, perhaps, learn that the double-footed condition is a peculiarity of this group of animals, not explainable by any general morphological considerations, but *sui generis*, after the manner of the branched segmental appendages of the Crustacea.—O. F. Cook.

Secretion of Potassium Hydroxide.—Mr. O. H. Lalter has some further notes[2] on the secretion of potassium hydroxide by *Dicranura vinula* and similar phenomena in other Lepidoptera. He finds that the imagines of eight species secrete from the mouth an alkaline fluid on emerging from the pupa. The three species of *Dicranura* wear what is called a shield, derived from the pupa case as they emerge, and they subsequently remove it by their legs. He finds that the strength of the solution in *D. vinula* is about 1.4 grm. of potassium hydroxide in every 100 ccm. of liquid. The mesenteron of the same species develops an anterior dorsal diverticulum for storage of the alkali during pupal life.—*Journal Royal Mic. Society.*

Lake Superior Coleoptera.—Mr. H. F. Wickham publishes[3] an admirable list of Coleoptera from the southern shore of Lake Supe-

[2] Trans Ent. Soc. Lond., 1895, 399-312.

[3] Proc. Davenport Acad. Nat. Science, VII, 125–169.

rior. More than 200 species are enumerated in this list which have not before been credited to the region of the Lake. The collections were made at Bayfield, Wisconsin, during June and July.

The following introductory remarks are of sufficient general interest to be quoted at some length. The time for an accurate map of the faunal regions of the continent has not yet come—nor will it before another century at least of careful investigation has enabled us to fix approximately the range of the rarer forms of insect life. It is evident to any one who will read with care and with some understanding of the general principles of distribution, that many of the recent theories as to the division of our country into "life-zones" have very little foundation in fact. If better proof were wanting of this, we might point to that of authors changing from year to year their arbitrary arrangement of our zoö-geographical regions—uniting to-day two or three of those of older authors, and separating them again a few months later on. All this may or may not be progress, but it will all have to be gone over again in the light of a wider knowledge than seems to be at present in the possession of certain writers who cannot rest without having first shown us that all previously conceived ideas are totally wrong, and that their explanation of the distribution of life is the only plausible one. A single group of animals may or may not indicate in a general way the lines of distribution followed by a larger number—but it is manifestly unreasonable to hope for a stable method of division of a country into life-zones before the life of that country is well-known.

EMBRYOLOGY.[1]

The Effect of Lithiumchloride upon the Development of the Frog and Toad egg (R. fusca and Bufo vulgaris.)[2]—The results of the series of experiments performed in the histological laboratory at Münich with this salt seem of no little interest, and especially is this the case with the result obtained with a 0·5 per cent solution. In every instance the eggs were placed in the solutions (varying from 1 per cent to 0·2 per cent) between a half and an hour and a half after fertilization.

[1] Edited by E. A. Andrews, Baltimore, Md., to whom abstracts reviews and preliminary notes may be sent.

[2] A. Gurwitsch, cand. med. Anat. Anz., XI, 65–70.

The blastula obtained with the 5% solution the author attempts, with some degree of plausibility, to make out to be of far reaching morphological importance. Whereas in all other cases development was either more or less hindered or was abnormal, in this case it was entirely symmetrical. The first indication of gastrulation appeared as a ring sinking about the equatorial plane and embracing the entire circumference. Sections showed a large mass of what the author calls passive yolk cells or endoderm forming the lower half, while the upper half, composed of a layer of ectoderm and one of active endoderm, forms a sort of cap covering it.

At a later stage this cap almost includes the lower passive entoderm, and, as the author points out, forms a gastrula that, if the passive yolk be removed, very closely resembles the gastrula of *Amphioxus*. From this it may seem more or less probable that the primitive amphibian gastrula may have been radially symmetrical, and that bilateral symmetry appeared later. Further it appears that the upper or large invagination of the amphibian egg is not the blastopore, but this is represented by the entire circle including the yolk plug.

It may be noted also, that if instead of supposing the passive entoderm to be removed, it be supposed to be greatly increased, one then has a gastrula of the meroblastic type.

Another point of interest is the manner in which the cells of the so-called "active endoderm," or those bordering the equatorial ring, proliferate. This proliferation according to the author has already begun when the invagination of the outer surface commences ; so that instead of there being a *pushing in* of the outer surface, as the process is usually described, there seems to be a *pulling in*. Whether this process is due to the "cytotropism" described by Roux for the cells of the dividing frog egg, or to the taking up of the space occupied by the absorbed contents of the blastula cavity, as described by Hatschek for *Amphioxus*, is not clear.

The embryos obtained differ from those obtained by O. Hertwig with NaCl, in that the brain capsule does not close up and the dying away of the brain matter does not take place, and again instead of the animal cells breaking down as in NaCl, it is the yolk cells that crumble away.

Finally one abnormal lithiumchloride embryo has an adverse significance for the concrescence theory.

It is to be hoped that the author intends later to publish a more extensive paper, which shall be more fully illustrated.—F. C. K.

ANTHROPOLOGY.[1]

An Inquiry into the Origin of Games.—An examination of the games of the Far East (Korea, China and Japan) and a comparison of them with certain games of the North American Indians as explained by Mr. F. H. Cushing, has induced Mr. Culin (Korean Games, with Notes on the Corresponding Games of China and Japan, by Stewart Culin, Director of the Museum of Archeology and Paleontology of the University of Pennsylvania, Philadelphia, 1895) to believe that the true game in the American and Asiatic region referred to, is a traceable descendant of primitive religious divinatory formulæ, reaching back to a time in the process of human development, when man freshly inspired by the phenomena of earth an sky, symbolized in his ceremonies the directions of the four winds, and foretold fate or fortune with arrows.

Because American Indians divine by arrows, because archery, and sets of arrows corresponding in number to Asiatic cosmic divisions, arrow derived grave posts, and guild tallies notched and named like arrows, still survive in Korea, and because arrow like rods are still used there in divinatory formulæ by fortune tellers, Mr. Culin has been led to regard arrow divination as a primitive and original form of fortune telling, and while the totemic arrow marks on short round gambling

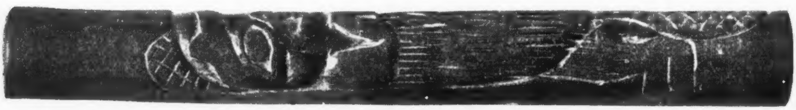


Fig. 1. Haida Indian gambling stick suggesting derivation from the arrow. One of a set of 32 bearing devices of the totemic animals of the worlds' quarters supposed to have been derived (traceably perhaps through an intermediate set marked with colored ribbons) from arrow shaftments such as were used by the McCloud River Indians.

sticks of northwest coast Indans are urged as indications of the arrow ancestry of the latter, the same interesting suggestion is made as to the cylindrical earthen stamps from Ecquador and the round and flat engraved cylinders from Babylonia. Twenty-three out of the ninety-seven Korean games described (though in many cases the clue is not

[1] This department is edited by Henry C. Mercer, University of Penna, Phila.

stated) and particularly games played on diagrams like the Korean *Nyout*, (*Pachesi*) or chess, are held to suggest a primitive divining board

Fig. 2. Cylindrical earthenware stamp from Ecuador suggesting derivation from the arrow. It bears a highly conventionalized device representing a bird. It's striking resemblance to the Haida gambling sticks suggests its own derivation from the carved shaftments of arrows and furnishes also a clue to the probable origin of the Babylonian seal cylinders.

—the world, with the quarters of the four winds "the heavens above and the earth beneath," where the relations of arrows thrown, scattered red or distributed, symbolized the early callings of man upon fate, the first soothsayer's translation of unseen causes into the events of life.

The investigation deals with evanescent and elusive conditions and of necessity the family tree of games is often vague and disjointed. An etymology, arrow notches on a card, scorings on sticks, the pas-

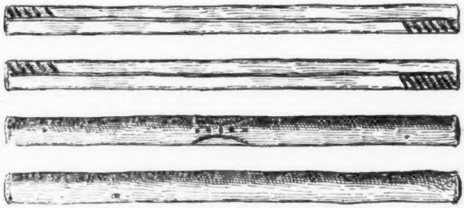


Fig. 3. Count Staves of wood used by Kiowa Indians suggesting derivation from arrows, emplosed in the game of *Zohn ahl*, they are inscribed with marks resembling arrow decoration and shaftment.

times of Indians in America and of far Orientals in Asia depending often upon the impartial testimony of the investigator have seemed to lead hnmanity backward in the cases and countries cited, not to the flight of birds, the observed instincts of animals, or the virtues of plants or minerals, but to the arrow as the ancestral symbol of the human necromancer. The Korean game of *Nyout*, where the throwing of marked sticks scores on a dotted diagram, seems related to divi-

nation because its arrangement of dots looks like magical diagrams in an ancient Chinese book of divination while there are throws, and

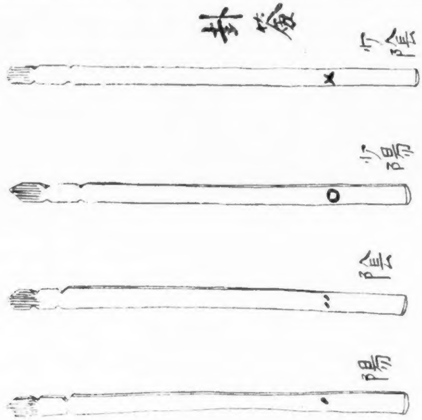


Fig. 4. *Kwa Zsin* Chinese (wooden) divining splints. Four of a set of sixth-four, suggesting by their notched points and name (*tsim* resembling *tsin*, arrow) a derivation from arrows.

arrangements, and suites, and figures in the game that seem to connect it with chess, and with dice and backgammon and other Korean dice and board games, thus, we are told, putting the latter familiar and Europeanized class of games into the line of succession from the primitive formulæ of the arrow diviner. Long narrow Korean playing cards, resembling a set of Chinese lottery arrows similarly marked,

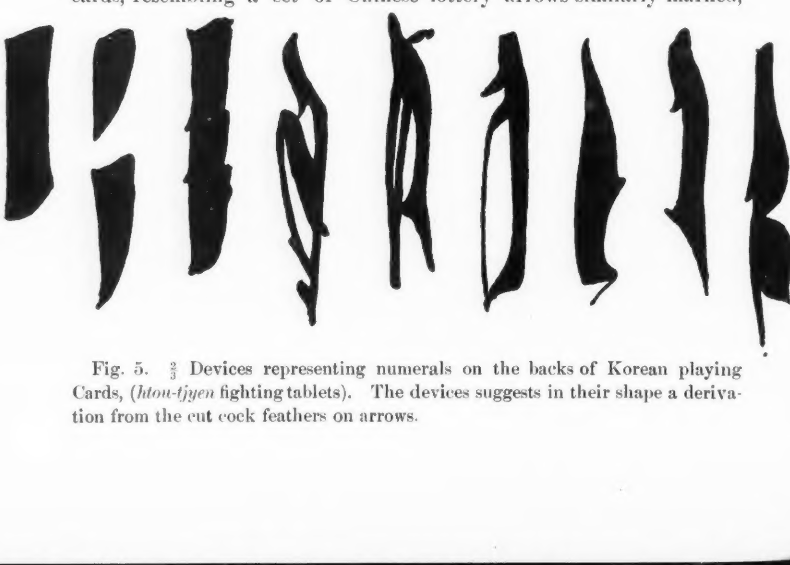


Fig. 5. $\frac{2}{3}$ Devices representing numerals on the backs of Korean playing Cards, (*htou-tjyen* fighting tablets). The devices suggests in their shape a derivation from the cut cock feathers on arrows.

and with arrow feathers painted on their backs refer us strikingly to the arrow, and this fact, illustrated by aseries of surprising pictures is one of the telling features of Mr. Culin's book. Whether we agree or not, whether we prefer to wait till more evidence is in for regions like parts of Australia, Tasmania and the Andaman Islands where man appears never to have had arrows, and whether we believe that we have reason to doubt that the notion of the four world quarters ever was universally impressed upon humanity the original suggestions of Mr. Culin pointing out new and seemingly widespread relations among games and tracing or seeking to trace in them fresh illustration for the story of human development, is of importance and interest.

Following further the author's dignified and always sympathetic presentation of the subject into a description of other games which sometimes, like the counting out rhymes of children, are regarded as less conscious survivals of the diviners' doings, sometimes as mere festive or athletic pastimes, we gather pleasing evidence of the world kinship of children in the record (often illustrated by native Korean artists in color), of blind man's buff, leap frog, horse stick, tug of war, stone fighting, pop guns, tops, tilt ups, and jack stones. Too briefly the pages reflecting remembered joys of youth tell of the loosened waters of a brook breaking, if they can, a juvenile dam, of hostile kites sawing their abraisive strings as they soar, of violet whipping, of shovel playing, of youthful mouths crammed with cherries, to be eaten without swallowing the stones, and of dragon flies, caught in spider webbed hoops by children reciting poems and released with unconscious cruelty when impaled with paper banners. But new aspects of an ever present floral sympathy in the land of cherry blossoms and the chrysanthemum are revealed to us when we learn of such Japanese names for bands of combatants as "spring willow blossom," "summer rest forest," and "autumn garden," shouted across the green turf in the foot ball game.

Notwithstanding the similarities urged between some of the arrow games of North America and their Asiatic representatives we look in vain in the book for suggestion of contact of races, or proof of migration. Lines of investigation such as other observers might choose in tracing the rolling of stone discs scored in motion with sticks or arrows (*Chungke*) from the Sandwich Islands to Georgia, the author eschews as unfruitful and inconclusive "unless supported by linguistic evidence." His valuable and original investigation has not essayed to furnish new light as to the geographical origin of the human race but has rather multiplied the evidence showing that man's mind has worked alike everywhere.—H. C. MERCER.

PSYCHOLOGY.

Prof. Mark Baldwin on Preformation and Epigenesis.—In the last number of the NATURALIST was republished from *Science*, Prof. Baldwin's observations on my presentation of the contrasted hypotheses of the development of mind.[1] One of these theories was supposed to be in accordance with the evolutionary doctrine of preformation, the other was thought to bear the same relation to that of epigenesis. Prof. Baldwin asks why the three theses arranged under epigenesis may not with equal or greater propriety be arranged in the preformation column. He believes that consciousness has had an influence in directing the course of evolution in accordance with the "general law now recognized by Psychologists under the name of Dynamogenesis—*i. e.*, that the thought of a movement tends to discharge motor energy into the channels as near as may be to those necessary for that movement." He also says, "I do not suppose that any naturalist would hold to an injection of energy in any form into the natural processes by consciousness. The psychologists are, as Mr. Cattell remarks, about done with a view like that." Prof. Baldwin also remarks that "Prof. Cope can say whether such a construction is true in his case." He adds that "it is only the physical basis of memory in the brain that has a causal relation to the other organic processes of the animal."

To reply to the last question first. The facts seem to show that conscious states do have "a causal relation to the other organic processes of the animal." I have gone into this subject briefly, but more fully than can be done here, in Chap. X of my book on the "Primary Factors of Organic Evolution" (1896). The evolution of the brain, the organ of consciousness, would indicate this, as well as the evidence for Kinetogenesis or evolution by motion. This would follow, if the doctrine of Dynamogenesis referred to by Prof. Baldwin be true, at the psychic end of the process, and if acquired characters be inherited, as required by the doctrine of epigenesis If then consciousness has such a function, the question arises as to its immediate mode of action. Prof. Baldwin says "only the physical basis of memory has a causal relation," etc. This proposition I can accept, and it is true whether that physical basis be due to a conscious state called a sense-impression, or not. But the directions of the acts (motions) which flow from that physical basis are very various in organic beings, having adaptations

[1] See Primary Factors of Organic Evolution, 1896, p. 14.

to as many ends as there are benefits to be obtained. It is evident that the physical basis of memory undergoes a change from the condition in which it is first produced. Its component parts are evidently rearranged in accordance with some purely psychic factors, *i. e.*, in accordance with qualities and properties which are only appreciable by conscious states. One may suppose that a reflection of the physical basis of a memory may be transmitted to different parts of the cortex, and that in one part it is located in accordance with one criterion of classification, and in another region in accordance with another criterion. In other words, the representative functions of the brain control the structure of the physical basis of memory, or cause a modified reproduction of it. These representative functions may be of the simplest —*i. e.*, they may consist only of criteria of size, color, utility, etc., or they may be more complex, involving judgments, concepts, etc. Finally, no criteria can violate the ultimate "forms of thought," which are essentials of all representative mental action. These, in short, are the fundamental reasons why mental conditions may be believed to direct the course of energy, without increasing the amount of that energy.

The relation of this factor of evolution to the the theories of Preformation and Epigenesis may be now considered. The reason why I believe that the process of mental evolution has been and is at bottom epigenetic, is because there is no way short of supernatural revelation by which mental education can be accomplished other than by contact with the environment through sense-impressions, and by transmission of the results to subsequent generations. The opinion is simply a consistent application to brain tissue of a doctrine supposed to be true of the other organic structures. The injection of consciousness into the process does not alter the case, but adds a factor which necessitates the progressive character of evolution.

I do not perceive how promiscuous variation and natural selection alone can result in progressive psychic evolution, more than in structural evolution, since the former is conditioned by the latter. The objections to this mode of accounting for progressive structural evolution are well known, and are enumerated in my book on page 474. It is true, no doubt, that as we rise in the scale of mental faculty the capacity for acquisition increases. How far these acquisitions are in inheritable is a question of detail, but no one denies, so far as I am aware, excepting consistent preformationists, that they are more or less inheritable. It is to be supposed that the longer special aptitudes are cultivated the more likely they are to be inherited, precisely as the ef-

fects of constant use of an organism are inherited, while sports and mutilations are not inherited. The importance of the social influences among men on which Prof. Baldwin justly lays so much stress, consists in the fact that they are continuous in their operation, and produce permanent habits. This accounts for the phenomena referred to by him when he remarks that "the level of culture in a community seems to be about as fixed a thing as moral qualities are capable of being; much more so than the level of individual endowment.. This latter seems to be capricious or variable, while the former moves by a regular movement and with a massive front." Here we have portrayed exactly what occurs in structural evolution. The habitual influence of the environment, internal and external, conditions the steady advance, while sports produce only temporary effects or are effective only in proportion to their ratio to the entire movement.

In an essay published in Science of March 20th, 1896, Prof. Baldwin comments on the lectures of Prof. Lloyd Morgan, in support of his own doctrine of Social Heredity. This is the name he has applied to this transmission of habits through their persistence in societies, so that the young acquire them through imitation or instruction, without the intervention of physical heredity. As a foundation for this view he disputes the necessity of any inheritance of acquired habits by the inheritance of the nervous mechanism which they express, and denies therefore that use is a necessary agent in the evolution of such habits. In order to prove that instincts are not "lapsed intelligence" he says; "The intelligence can never by any possibility create a new movement or effect a new combination of movements, if the apparatus of brain, nerve and muscles has not been made ready for the combination which is effected. This point is no longer in dispute," etc. Immediately before this, however, he says. "But let us ask how the intelligence brings about coördinations of muscular movement. The physchologist is obliged to reply; "Only by a process of selection (through pleasure, pain, experience, association, etc.,) from certain alternative complex movements, which are already possible for the limb or member used."

It is granted in the last quotation that pleasure, pain and other conscious states, select the motions which become habits. Such selection is intelligent, and such act is an expression of intelligence, though of the simplest sort. All that Prof. Baldwin alleges is that intelligence is impotent to construct the mechanism of new habits out of mechanisms already too far specialized in definite directions to permit such a reorganization of structure. This truth in nowise contradicts

the construction of the mechanism of new habits from tissues capable of reconstruction or of modification, a quality which resides very probably in brain tissue, or at least certainly has resided in it at various stages of organic evolution, when new "selections through pleasure, pain, experience, association, etc.," were made; otherwise the selection would have been impossible. This is the history of all the other tissues, and why not of brain tissue? Though Prof. Baldwin denies the necessity of the Lamarckian Factor, he admits it in this doctrine of selection; and his denial of inheritance, only covers the case of physchological sports, as above pointed out. Hence he both admits and denies both Lamarckian and Weismannism.

Weismannism has recently struck the physchological camp, and in Prof. Baldwin and in Mr. Benjamin Kidd, we see some of its recent effects. But since the biologists have generally repudiated Weismannism, the evolutionary physchologists must try and get along without it. Nevertheless, as above remarked, Prof. Baldwin's "Social Heredity" is a real factor, especially in human evolution; but as it is not heredity, I think it should have a new name, which shall be less confusing.

E. D. Cope.

Psychologic Data Wanted.—For purpose of extended comparison I wish data as to habit, instinct or intelligence in animals, above all, minor and trifling ones not in the books, *useless* or *detrimental* ones, and the particular *breed*, *species* or *genus* showing each. Purring, licking, washing face, kneading objects with fore-paws, humping back, and "worrying" captured prey (like the cat), baying (at moon or otherwise); urination and defecation habits (eating, covering up, etc.); disposition of feces and shells in nest; rolling on carrion; cackling (or other disturbance) after laying; eating "afterbirth" or young; sexual habits; transporting eggs or young; nest-sharing; hunting partnerships or similar intelligent associations; hereditary transmission of peculiarities; rearing young of other species with resulting modification of instinct; feigning death; suicide; "fascination;" are examples. Circular of information will be sent and full credit given for data used, or sender's name will be confidential, as preferred.

Answer as fully as possible, always stating age, sex, place, date (or season), species, breed, and whether personally observed.

R. R. Gurley, M. D.

Clark University, Worcester, Mass.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Nova Scotian Institute of Science.—March 9th.—The following paper was read: "Some Illustrations of Dynamical Geology in Southwestern Nova Scotia," by L. W. Bailey, Esq., M. A., Ph. D.

HARRY PIERS, *Secretary.*

Boston Society of Natural History.—February 19th—The following papers were read: Mr. Outram Bangs: "The Terrapin an Inhabitant of Massachusetts." Dr. Joseph Lincoln Goodale: "The Vocal Sounds of Animals and the Mechanism of their Production."

March 4th.—The following paper was read: Prof. F. W. Putnam: "Symbolism in Ancient America.".—SAMUEL HENSHAW, *Secretary.*

New York Academy of Sciences—Biological Section.—February 7th, 1896.—Dr. J. G. Curtis in the Chair.

A communication from the Council was received asking that the Section take action on Rep. Hurley's bill "To fix the standard of Weights and Measures by the adoption of the metric system of weights and measures."

On motion of Dr. Dean, the Section approved the bill and the Secretary was directed to express the entire commendation of it to the Council.

Dr. Arnold Graf read a paper on "The Structure of the Nephridia in Clepsine." He finds, in the cells of the intra-cellular duct, fine cytoplasmic anastamosing threads which form a contractile mechanism. These are stimulated by granules which are most numerous near the lumen of the cell, and thus a peristalsis is set up which moves the urine out of the duct. In the upper part of the intra-cellular duct, the two or three cells next to the vesicle or funnel have no distinct lumen, but are vacuolated; the vacuoles of the first cell being small, those of the second larger, and so on, till the vacuoles become permanent as a lumen. He explains the action of the first cell as being similar to the ingestion of particles by the infusorians. The matter taken up thus from the funnel by the first cell is carried by the rest, and so on till the cells having a lumen are reached. The presence of the excretum causes the granules to stimulate the muscular fibres of the cells; penstalis results and the substance is carried outwards. The character of this contractile reticulum offers an explanation of the structure of a cilium as being the continuation of a contractile reticular thread.

N. R. Harrington, in "Observations on the Lime Gland of the Earthworm," described the minute structure of these glands in *L. terrestris,* and showed that the lime is taken up from the blood by wandering connective tissue cells which form club-shaped projections on the lamellae of the gland, and which pass off when filled with lime. The new cell comes up from the base of the older cell and repeats the process. This explanation is in harmony with the fact that in all other invertebrates lime is laid down by connective tissue cells. Histological structure and the developmental history confirm it.

Dr. Bashford Dean offered some observations on "Instinct in some of the Lower Vertebrates." The young of *Amia calva,* the dogfish of the Western States, attach themselves, when newly hatched, to the water plants at the bottom of the nest which the male Amia has built. They remain thus attached until the yolk sac is absorbed. As soon as they are fitted to get food they flock together in a dense cluster, following the male. When hatched in an aquarium they go through the same processes. The young fry take food particles only when the particles are in motion, never when they are still. The larvæ of Necturus also take food particles that are in motion.—C. L. BRISTOL, *Secretary.*

American Philosophical Society.—January 17th.—Prof. Hilprecht presented a paper on "Old Babylonian Inscriptions, Chiefly from Nippur," Pt. ii.

February 21st.—Prof, A. W. Goodspeed read a paper on the Röntgen method, with demonstration. Remarks were made by Prof. Houston, J. F. Sachse, Prof. Robb of Trinity College, and Prof. Trowbridge of Cambridge.

March 6th.—The following paper was presented: "Eucalypti in Algeria and Tunisia from an Hygienic and Climatological Point of View," by Dr. Edward Pepper.

Academy of Natural Sciences of Philadelphia—Anthropological Section.—February 14th.—The following papers were read: Dr. Allen on "Prenasal Fossæ of the Skull;" Dr. Brinton on "Human Hybridism;" Dr. McClellan, Skulls and Photographs exhibited.
CHAS. MORRIS, *Recorder.*

The Academy of Science of St. Louis.—February 17, 1896.—Dr. Adolf Alt spoke of the anatomy of the eye, and, by aid of the projecting microscope exhibited a series of axial sections representing the general structure of the eye in thirty-one species of animals, comprising two crustaceans, the squid, three fish, two batrachians, two reptiles, ten birds, and eleven mammals.

Professor F. E. Nipher gave an account of the Geissler and Crookes tubes and the radiant phenomena exhibited by each when used in connection with a high-tension electrical current of rapid alternation, and detailed the recent discoveries of Professor Röntgen, showing that certain of the rays so generated are capable of affecting the sensitized photographic plate through objects opaque to luminous rays. Attention was also called to the experiments of Herz and Lodge with discharges of very high tension alternating currents, which showed that by the latter certain invisible rays are produced, which, like the Röntgen rays, are capable of passing through opaque bodies, such as pitch, but differing in their refrangibility by such media.

March 2d.—Mr. F. W. Duenckel presented a comparison of the records of the United States Meteorological Observatory, located on the Government building in the city, with the record for the Forest Park station, showing that the daily minimum averaged decidedly lower at the Forest Park station than in the city, while the wind averaged decidedly higher for the city station.

Professor E. E. Engler spoke on the summation of certain series of numbers.—William Trelease, *Recording Secretary.*

SCIENTIFIC NEWS.

The *Journal of Comparative Neurology*, which is now entering upon its sixth volume, has its editorial facilities considerably enlarged by the addition to the staff of Dr. Oliver S. Strong, of Columbia College. Professor C. L. Herrick continues as Editor in-Chief. The Managing Editor for 1896, is C. Judson Herrick, to whom business communications should be addressed at Denison University, Granville, O. Editorial communications may be sent to either of the three editors.